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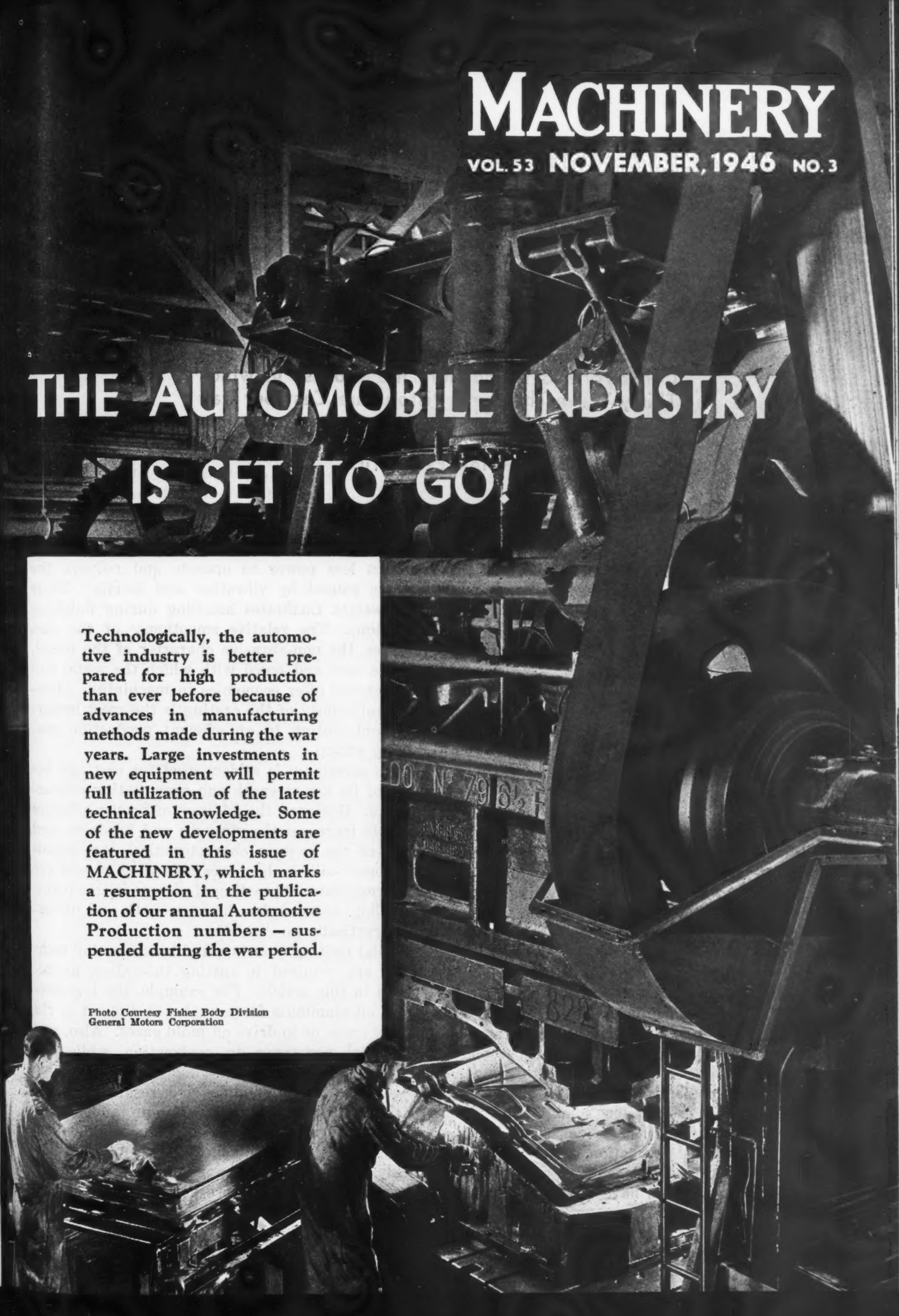
THE AUTOMOBILE INDUSTRY IS SET TO GO!



Technologically, the automotive industry is better prepared for high production than ever before because of advances in manufacturing methods made during the war years. Large investments in new equipment will permit full utilization of the latest technical knowledge. Some of the new developments are featured in this issue of MACHINERY, which marks a resumption in the publication of our annual Automotive Production numbers — suspended during the war period.

Photo Courtesy Fisher Body Division General Motors Corporation

Permanent-Mold Casting of Pistons by Chrysler's High-Production Methods

Melting, Pouring, Molding, and Aging Steps of a Conveyorized Production-Line Process in which Thirty-Three Thousand Pistons are Cast per Day

By CHARLES H. WICK

HIGH-PRODUCTION conveyorized lines have recently been installed at the Highland Park plant of the Chrysler Corporation for the gravity pouring of aluminum alloy in permanent piston molds. This installation has made possible the centralization of the major portion of this corporation's requirements for pistons. By centralizing the casting operation, more economical and increased production and uniformly improved quality of pistons are achieved, even though each division of the Chrysler Corporation machines its own pistons. A production of 33,000 pistons per working day is obtained with the centralized permanent-mold casting lines.

Permanent-mold casting of aluminum alloys is not new. Its use, however, has been greatly increased during the last few years with the development and improvement of the process and with more widespread knowledge of the results attainable. The advantages of permanent-mold castings over those produced in sand molds are improved mechanical properties, uniformity, increased production, smoother surfaces, soundness, and accuracy. Conservation of material is also effected because thinner sections can be cast without decreasing the strength, and less material needs to be allowed for finishing, as the parts are cast to more accurate dimensions. The improved mechanical properties of permanent-mold castings are principally due to the progressive solidification and rapid chilling that produces a dense, fine-grain product. With mass production, the mold costs become practically negligible.

Aluminum-alloy pistons have the advantages of high thermal conductivity, which makes cooling of the engine less difficult, and saving in weight, which requires less power to operate and reduces the stresses caused by vibration and inertia. Their light weight facilitates handling during finishing operations. The relative smoothness of the cast surfaces, the non-abrasive character of the metal, and the ease and speed with which the metal can be machined offer economies in machining. However, uniformity of the casting is the most important contribution to an efficient production machining set-up.

Pure aluminum is seldom used for castings because of its low strength and poor casting characteristics. However, the addition of proper alloying elements increases the strength and hardness and improves the casting characteristics. An aluminum-copper-silicon, heat-treatable alloy is used for the permanent-mold casting of pistons in this plant. This alloy, as aged, has high strength and undergoes practically no distortion.

Special melting, pouring, and heat-treating techniques are required in casting this alloy, as described in this article. For example, the low density of all aluminum alloys makes it difficult to rid them of oxide or to drive off mold gases. Also, any substantial resistance to contraction while the casting is passing through a temperature just below that at which it solidifies may result in cracks. Another characteristic of aluminum alloys that requires care in molding is its high solidification shrinkage. Such shrinkage takes place rather quickly when the metal changes from the liquid to the solid state. If this were not compensated for,

General View of Production Line where Molten Aluminum Alloy is Poured into Permanent Molds and Cast Pistons are Placed on the Conveyor

draws, surface shrinkage, porosity, or cracks would result.

The alloy is received from the smelters in the form of three-section ingots, each weighing from 25 to 30 pounds. The ingots are shipped in covered containers to prevent absorption of moisture. Each lot of ingots is carefully sampled and analyzed to see that the ingots conform with the specifications for chemical composition. A hole is drilled in the center and end sections of each sample ingot, and a separate chemical analysis is made of the chips obtained from each hole.

The ingots are melted in dip-well, gas-fired reverberatory furnaces, which are maintained at a temperature of 1300 degrees F. There are fifteen of these furnaces in use at the present time. Eight furnaces are installed along one production casting line, and seven along the other line, as shown at the top and bottom of Fig. 1. The furnace that is indicated with broken lines to the right of the lower production line represents future expansion when required.

Each furnace has two dipping wells at the end of the furnace that is adjacent to the casting machines, and one feeding well at the opposite end of the furnace. A view of the side of one of these furnaces is shown in Fig. 2. The man at the left is shown charging ingots into the feeding well, and

the man at the other end of the furnace is ladling molten metal from one of the dipping wells. The three wells of each furnace are connected by a common bath of molten metal. The metal flows from the feeding well through the bath, and up into the dipping wells without coming in direct contact with the heating medium. This minimizes the absorption of gas by the metal. The wells are constructed of a non-metallic, refractory material to minimize iron pick-up, and are approximately 30 inches deep. The level of molten metal desired is maintained by charging when required. Normal production, without charging, would lower the level of the molten metal approximately 1 inch per hour.

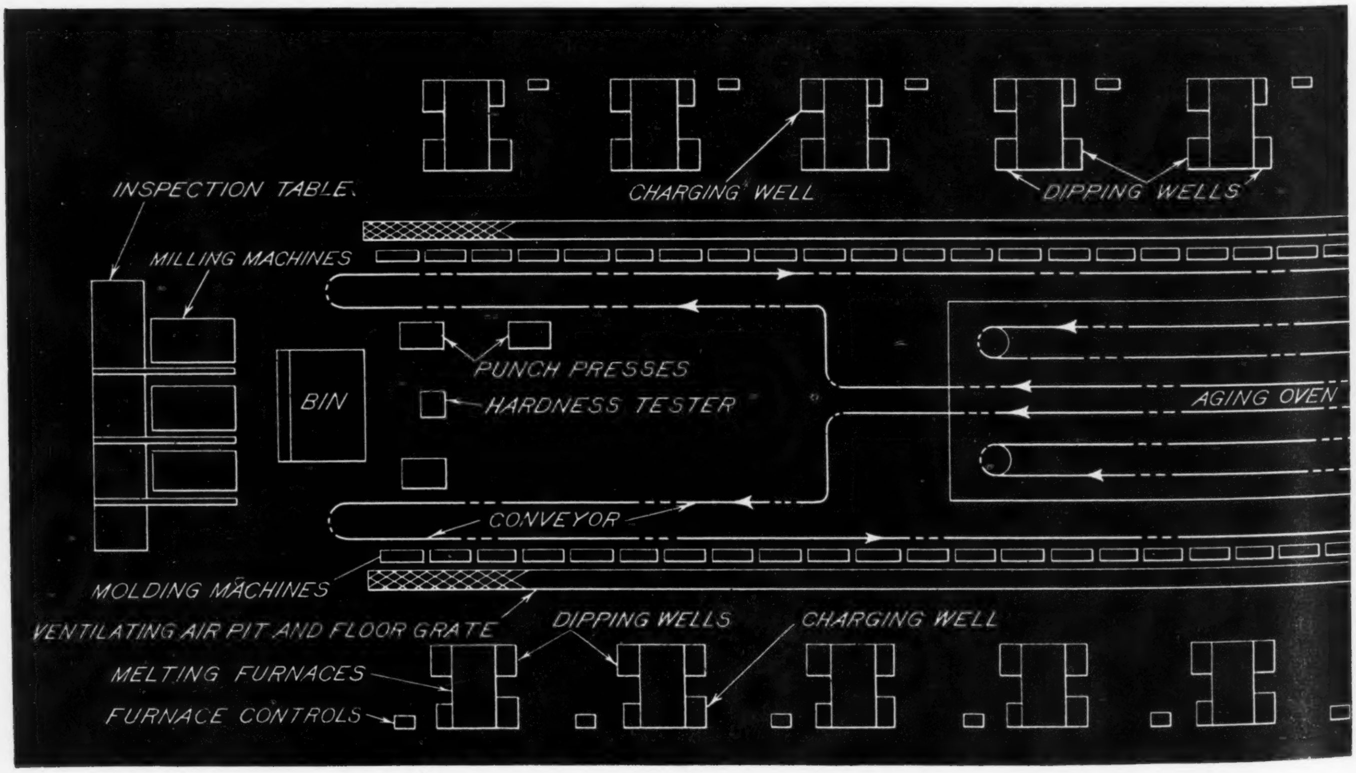
It requires from seven to eight hours to heat a furnace from room temperature to the melting temperature of 1300 degrees F. The temperature of aluminum alloys in either the solid or liquid condition is not indicated by distinct color changes. Therefore, it is necessary to employ pyrometers. An individual thermo-electric type of pyrometer, consisting of a thermo-couple located in the molten metal near the dipping wells, suitable compensating leads, and a calibrated potentiometer, is located near each furnace.

The temperature of the molten metal is regularly inspected with a portable potentiometer to insure that the temperature does not exceed that specified. This is very important, because aluminum alloy that has been overheated will show a coarser grain structure. The amount of oxide formed during melting also increases with the temperature.

Care is also necessary to insure that the ingots and ladles used for charging and dipping from the furnace are warm and dry, because the molten metal readily absorbs certain gases, particularly hydrogen. Water vapor, hydrocarbon gases, and other hydrogen-containing compounds will, under certain conditions, react with the molten metal and liberate hydrogen, thus causing minor explosions. Ingots to be charged and ladles not in use are stored near or on the furnace to facilitate drying.

The dipping of molten metal from the furnace is a technique that can only be developed by experience. Failure to exercise adequate care at this

Fig. 1. Lay-out of a Permanent-mold Casting Installation along their Respective Lines of Melting Furnaces and Cast-

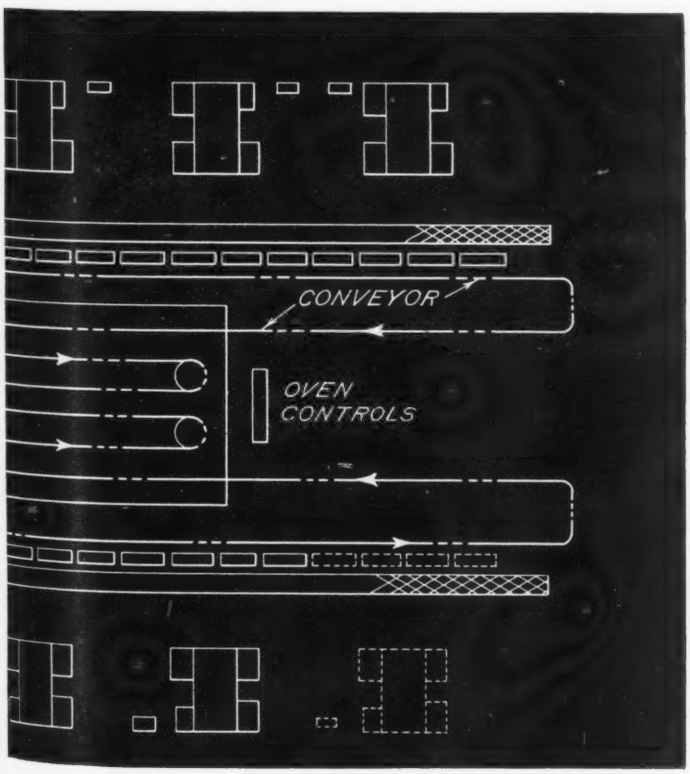


point in the process is reflected in a reduction of the quality of the casting. This is principally due to the readiness with which the surfaces of aluminum alloys combine with oxygen to form oxides. The amount of oxides formed during melting increases with the temperature, as well as with agitation. The specific gravity of aluminum alloys is sufficiently close to that of aluminum oxide to make separation difficult. The entrance of oxide into the mold is minimized by careful dipping.

The desirable method is to use the back of the ladle to push aside the layer of oxide and to scoop from the unoxidized molten metal beneath it. The oxide layer can be skimmed from the surface of the dipping well, but this is not entirely satisfactory. Continual skimming increases the total oxide loss, because each time the oxide coating is removed, a new one forms. However, to prevent excessive thickening of the oxide layer, it is skimmed from the dipping well every few hours.

A ladle having two lips is used in this process. The operator wears asbestos gloves during the operation. After filling the ladle from the dipping well, he rapidly carries it to the mold, several of which may be seen in the background of Fig. 2. The loss of temperature of the molten metal during this transfer seldom exceeds 20 degrees F. The molten metal is poured into the front and rear gates of the mold from the two lips of the ladle, as shown in Fig. 3. Here, again, care is required on the part of the operator, as the rate of pouring is very important. If it is poured too fast, the molten metal is agitated, thus trapping and carrying air and dross into the mold cavity. On the other hand, if it is poured too slowly, an inferior casting may result. With experience, an operator develops an ideal pouring cycle, wherein the speed varies with the amount of material poured. The streams of molten metal entering the mold cavity should not be broken until the end of the cycle, and the ladle should be held as close to the gates as possible.

Consisting of Two Conveyors which Pass ing Machines, and then Enter an Aging Oven



Construction of Molding Machine, Mold, and Core

There are sixty molding machines installed in this shop at present. Thirty-two of the machines are installed along the production casting line shown at the top of Fig. 1, and twenty-eight along the lower line. This set-up aligns four machines with each furnace. One operator works from each side of a furnace, ladling from the dipping well and casting in two molding machines.

The molding machines are hydraulically operated by means of a right- and a left-hand horizontal hydraulic cylinder, and a lower vertical hydraulic cylinder, all mounted on a common base. The hydraulic cylinders are actuated by oil at a pressure of 300 pounds per square inch, which is piped to the cylinders from centrally located pumps and accumulators.

The piston is cast with its axis vertical and its diameters in horizontal planes. The outer surface of the piston is formed by two equal and similar mold sections, which are bolted to movable die-blocks on the machine. These die-blocks, with their respective mold sections, are moved together and apart on ways bolted to the machine base by the action of the right- and left-hand hydraulic cylinders. The left-hand mold section, the die-block to which it is bolted, and the ways in which it slides may be clearly seen in Fig. 4.

These mold segments are made from a special grade of close-grained, heat-resistant cast iron.

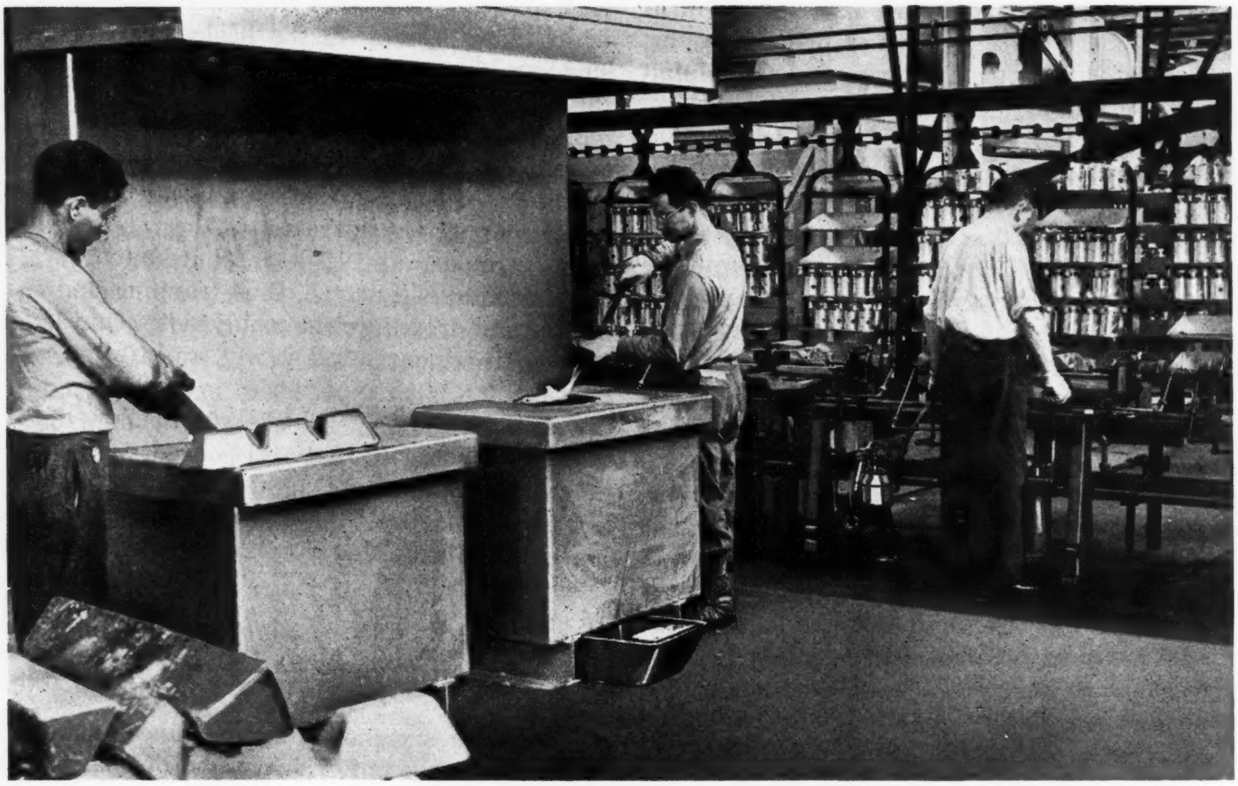


Fig. 2. A View of the Side of One of the Melting Furnaces. The Man at the Left is Charging Ingots into the Feeding Well, while the Man at the Right is Ladling Molten Metal from One of the Dipping Wells. A Line of Casting Machines and One of the Conveyors May be Seen in the Background

The parting face of one half of the mold contains a dowel which fits into a hole in the other half to insure accurate alignment of the sections with each other. This snug fit of the mold sections is necessary to insure positive sealing during pouring, obtain dimensional accuracy, and prevent leakage. The mold segments also contain core-pins which form the piston-pin holes.

The core, which forms the inside of the piston, is made in three parts—a center core segment, a right-hand core wing, and a left-hand core wing. The inner surfaces of the right- and left-hand core wings mate with the ground sides of the center core segment when the core is in the casting position, as shown in Fig. 4. The center core segment is raised to the casting position or lowered below the wings mate with the ground sides of the center core plunger to which it is bolted. The wings are mounted on plates within the base of the machine, and they can be moved mechanically toward each other when the center core is retracted by means of levers connected to hand-toggles that extend out from the front of the machine. The core segments are machined from a special grade of high-speed steel and then treated to maximum hardness.

When the mold halves have been brought together, they form the front and rear gates and feeders through which the molten metal is poured, as well as the central vent which forms the large sprue that contains most of the gases and dross. The size and location of the gates and feeders are such as to insure the highest possible rate of flow that will not cause agitation or cold-shots. To minimize agitation, the cross-sectional area of the feeders is made considerably less than that of the gates, thus reducing the rate of flow.

The heavy sections of the piston are cast at the parting line of the molds, so that they can be fed directly from the gates. The gates and feeders are made sufficiently high to provide a head of molten metal that will reach all parts of the mold cavity. The thickness of the mold is such as to achieve

Fig. 3. Molten Metal is Carefully Poured from a Two-lipped Ladle into the Permanent-mold Cavity. Pouring Must be Timed Carefully to Insure Proper Solidification and Prevent Agitation

maximum uniformity of heat distribution, so that solidification in the casting will be progressive. Uniform temperature in the mold is not required, since a temperature gradient across certain sections will give the ideal thermal condition for the desired rate of solidification.

The portion of the mold halves that is exposed to the air is sufficient to permit uniform cooling. The center core segment, having only a small area exposed to the air, is tapped and water is circulated through it to facilitate cooling. The molds are designed so that solidification starts at points farthest removed from the gated area and proceeds progressively to the risers which provide molten metal to take care of shrinkage. If the design is such that proper cooling is not allowed for, thin sections will solidify first, thus preventing the feeding of molten metal to other sections and causing voids, strains, and planes of weakness. The large vent that is formed by the top surface of the mold halves is required because of the poor permeability of the iron molds.

Preparation and Operation of Mold

In starting production, the molds are cleaned with a wire brush, heated with a gas flame from a hand-torch, and painted by means of an air-operated spray gun. The cleaning is necessary to remove the paint remaining from previous operations, since the paint would crack and peel when the heat expanded the mold. The purposes of mold painting are to prevent the molten metal from "freezing" to the mold and to help control the rate of solidification.

The paint consists of a refractory material which acts as an insulator to retain the heat, a lubricant to assist in parting the mold and the casting, and

Fig. 4. Paint Containing a Refractory Material is Sprayed on the Mold Faces, Cores, Gates, Runners, Risers, and Pins to Prevent Molten Metal from "Freezing" to the Parts and to Control the Rate of Solidification

Fig. 5. Cast Pistons are Removed from the Molds by Means of Tongs Manipulated by the Gloved Operators. The Pistons are Put on Trays Suspended from the Conveyor

a binder—all suspended in water to permit application with a spray gun. The refractory material tends to settle out of solution, so that it must be thoroughly mixed before being transferred to the cup of the spray gun.

It is sprayed on the mold faces, cores, gates, runners, risers, and pins, as shown in Fig. 4, as well as on the ladles. The thickness of the coat of paint applied varies with the section of the mold, depending upon the chilling effect desired. For example, gates and runners are given a heavier coat of paint to retain the heat of the molten metal, thus allowing it to flow more easily. Paint is removed or the thickness is reduced by scraping parts of the mold that form sharp changes in the piston section, thus permitting the chilling of such parts.

The painted mold is then reheated with the torch

Fig. 6. Close-up View of Cast Aluminum-alloy Piston, Showing the Smooth Surface Finish Imparted by the Permanent Mold. The Sprues Formed by Gate and Runner are at Each Side, and the Large Sprue Formed by the Vent is at the Top Center

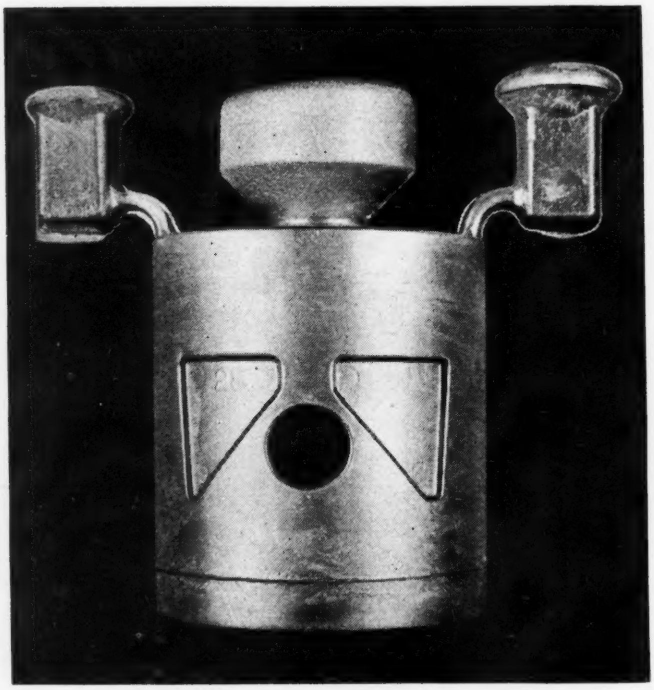
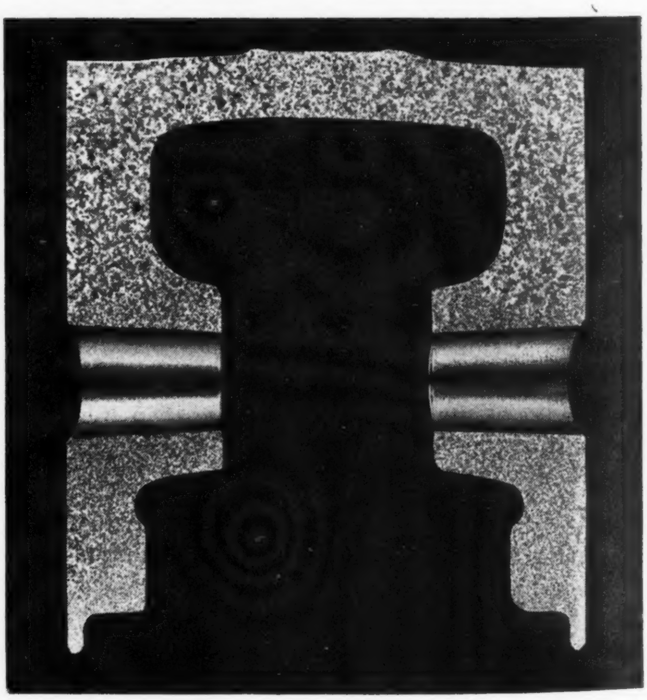


Fig. 7. Sectional View of Aluminum-alloy Piston Produced by Permanent-mold Casting, Showing the Fine Grain Structure that is Obtained by Subjecting the Piston to Heat-treatment in the Aging Oven Illustrated in Fig. 8



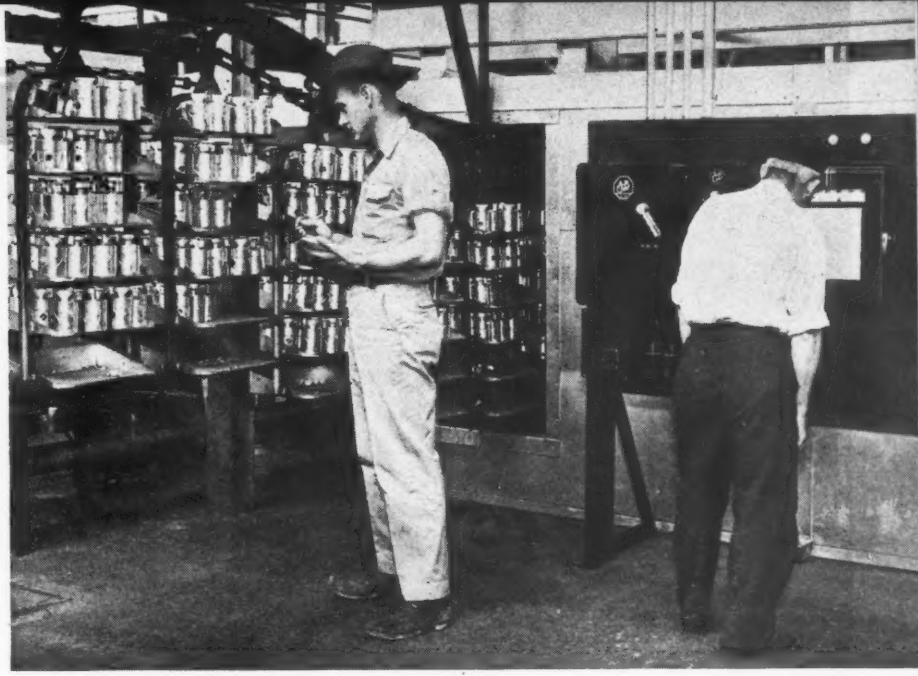


Fig. 8. Each Conveyor Turns 180 Degrees from the Casting Lines and Enters the Aging Oven, where the Pistons are Subjected to a Heat-treatment of Six Hours at 400 Degrees F. The Man at the Right is Inspecting the Recording Controls of the Oven

to compensate for any loss in temperature during painting. The coat of paint ordinarily lasts during the working day. However, it is regularly inspected and touched up when necessary. The first few pistons cast at the beginning of a production run are remelted until the molds reach the operating temperature of approximately 700 degrees F. This is necessary because rapid solidification due to a cool mold would cause non-uniform cooling, resulting in inferior castings.

A single hydraulic control valve and the two hand toggles are used to operate the molding machine. When the hydraulic valve is depressed, the two halves of the mold are brought together by the plungers of the right- and left-hand hydraulic cylinders. Simultaneously, the center segment of the core is raised by the plunger of the vertical hydraulic cylinder to its place between the right- and left-hand core wings. The mold and core segments are held in this position during molding by the hydraulic pressure. It takes approximately one minute and ten seconds for solidification of the pistons, the time depending upon the temperature of the mold and molten metal. The sprues are closely observed, and give a good indication of the condition of the metal in the mold.

When the sprues indicate that the piston has solidified, the hydraulic control valve is moved to the "off" position. This reverses the pressure in the cylinders and retracts the two mold segments and the center core piece. The hand-operated levers are then shaken to loosen the piston from the core wings. The piston is now lifted from the mold with tongs, as shown in Fig. 5, and placed on a tray of one of the conveyor containers. A close-up view of a cast piston is shown in Fig. 6.

There are two continuous chain conveyors used in this set-up—one for the production line shown at the top of Fig. 1, and the other for the line at the bottom. The conveyors are 418 feet long each, and are driven by a geared speed reducer at the rate of 6 inches per minute. Each conveyor is loaded from one of the two lines of melting fur-

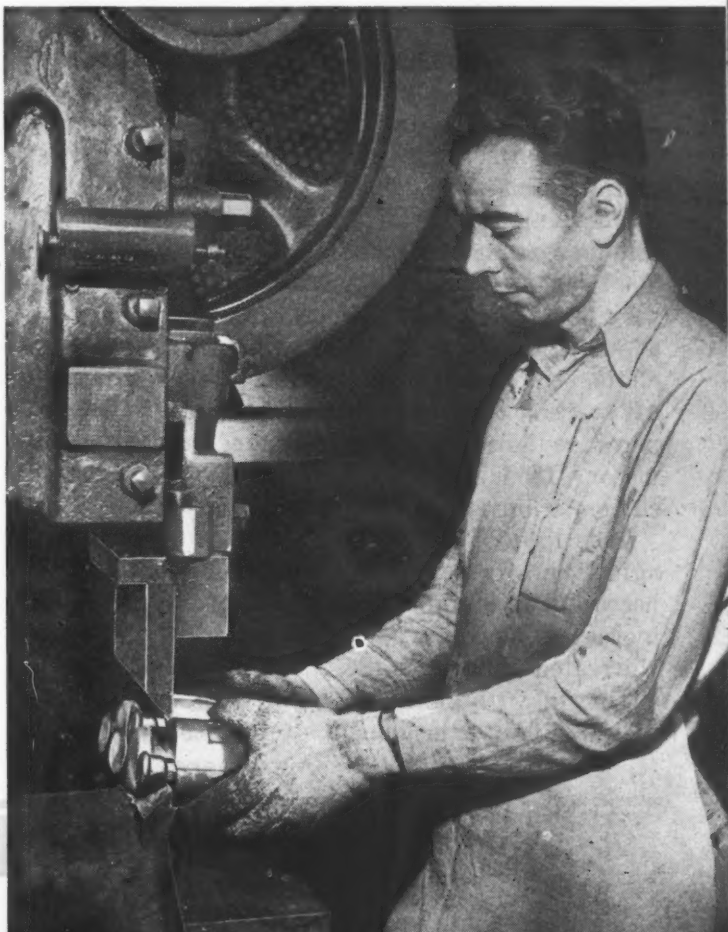


Fig. 9. The Sprues and Runners are Sheared from the Piston on Punch Presses as Shown

Fig. 10. After the Sprues and Runners have been Sheared off, the Remaining Sprue is Removed on a Rotary Milling Machine to Insure a Flat Surface

naces and molding machines. The conveyors turn 180 degrees from these casting lines and enter the aging oven, as shown in Fig. 8. Each conveyor makes two 180-degree turns in the oven, which is approximately 60 feet long by 18 feet wide, thus carrying the pistons through the oven a distance equal to about three lengths of the oven and out the opposite end, as shown in Fig. 1.

The oven length and conveyor speed are such that the pistons are in the oven for six hours. Since the six trays of each container hold ninety pistons and the containers are spaced with center distances of 2 feet, 16,000 pistons can be simultaneously treated in the aging oven.

The aging oven is heated by gas, and the temperature is carefully maintained at 400 degrees F. The temperature in each half of the oven is recorded on separate controls, which may be seen at the right in Fig. 8.

The temperature of the cast piston when it is removed from the molding machine varies from 850 to 900 degrees F. As aluminum alloys have a very low strength at temperatures just below that at which they solidify, the casting is placed on one of the six trays of a conveyor container in a vertical position to avoid distortion. This elevated temperature is a decided advantage, preventing the pistons from cracking due to rapid temperature change while in an unsupported position.

This type of heat-treatment is called "artificial aging" or "precipitation heat-treatment." It is necessary to stabilize the growth of the piston and increase its hardness and other physical properties. Untreated aluminum-alloy pistons, when run in an engine, have been found to increase permanently in size. This enlargement of the piston is designated "permanent growth," as distinguished from normal thermal expansion.

Both "permanent growth" and distortion are less than ordinary thermal expansion, but this prior heat-treatment minimizes such difficulties and permits the use of closer tolerances. The specification met by this growth stabilization treatment is that an additional heat-treatment of ten hours at 390 degrees F., which approximates the operating temperature, shall not cause a permanent growth of more than 0.001 inch in any dimension.

The hardness of the piston after casting and air cooling varies from 100 to 110 Brinell. After aging, the hardness is increased to from 122 to 130 Brinell. Tests have shown that such an aging treatment at 400 degrees F. for sixteen hours would decrease the hardness. The strength is also improved by this hardening. A tensile load of 16,000 pounds is required to pull the head from the skirt of a machined piston.

During this treatment, $CuAl_2$ precipitates out of the solid solution in a finely dispersed pattern. In this condition, the particles act as keys and interfere with slippage among the crystals, thus increasing the hardness and strength of the alloy. The fine grain structure obtained from this combination of casting procedure and heat-treatment can be seen from the section of a cast piston shown in Fig. 7.

Removal of Sprues and Inspection

As the conveyors leave the oven, they make two 90-degree turns and one 180-degree turn to again pass along their respective lines of melting furnaces and casting machines, as shown in Fig. 1. The heat-treated pistons are removed from the

Fig. 11. The Pistons are Inspected Visually for Cracks, Porous Areas, and General Appearance. Rejected Pistons are Returned to the Melting Furnaces

trays along this portion of the conveyor, and are stacked beside punch presses. The presses are provided with shear blades for chopping off the sprues and runners close to the head of the piston, as shown in Fig. 9. The sprues and runners contain some trapped gases, but very few impurities. Hence, they are collected and returned to the charging wells of the melting furnaces.

Rotary milling machines similar to the one shown in Fig. 10 are used to remove the surplus sprue from the top of the piston. The pistons are placed in a vertical position, with their heads up, in the eighteen work-holding stations of a fixture mounted on the bed of the machine. The pistons are clamped in pairs by means of movable and fixed V-blocks. The inner faces of the V-blocks are provided with grooves that engage the periphery of the piston and keep it from rotating. The outer face of the movable V-block comes in contact with rollers mounted on the front of the machine column, which force it toward the fixed V-block, thus clamping the pistons.

After the work has passed under the cutter, a spring mounted between the V-blocks forces them apart. The pistons are then lifted from the fixture and placed in chutes adjacent to the machine, down which they roll to the inspection table.

The pistons are inspected visually, as shown in Fig. 11, for cracks, porous areas, and general appearance. The inspector shown at the right is placing a rejected piston in a chute which carries it to the metal bin located at the left of the table. Such rejected pieces are returned to the furnaces for remelting and recasting. Scrap castings that are coated with oil, grease, moisture, or oxide may produce sufficient gas to cause unsound castings. Such castings are often preheated before melting to drive off these volatile materials.

Pistons that pass inspection are temporarily placed in a vertical position on the table. They are periodically loaded on dollies, similar to the one shown in the background, for transportation to the machine shops of the engine plants for which they were cast.

A feature of this production line that adds to the comfort of the employes, is a ventilation system. Pits covered with steel floor grating are placed between the rows of melting furnaces and molding machines, as shown in Fig. 1. Air from outside the building is forced through these pits and up through the grating. The air is drawn up and out through the roof by exhaust fans. This creates a pleasant air circulation that offers the operators relief from the hot furnaces and molds.

Procedure Followed in One of the World's Most Modern Electroplating Departments, which was Established at a Cost of over a Million Dollars to Improve Product Quality

By CHARLES O. HERB

ONLY by technological advancements can the automobile and many other high-production industries manufacture their products at a cost that will permit a competitive and profitable selling price and at the same time make it possible to maintain high quality. Reconversion programs were therefore planned on the basis of improving manufacturing technique as much as possible over pre-war methods.

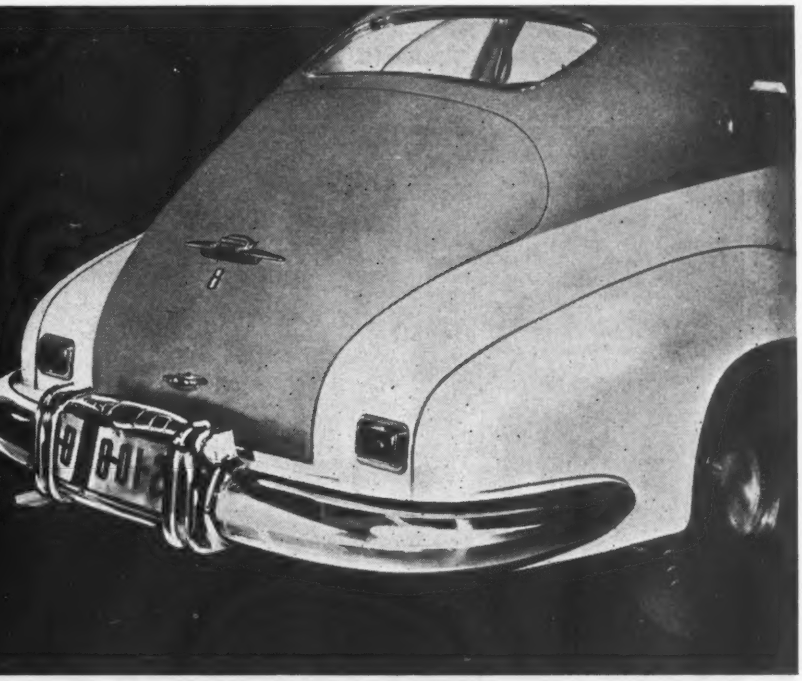
One of the outstanding improvements made by the Oldsmobile Division of the General Motors Corporation has been the installation of automatic polishing and plating equipment, which gives the concern one of the most modern departments of this type in existence anywhere. This department is set up primarily for finishing the three-piece bumpers that are a feature of today's Oldsmobiles. Over one million dollars was expended in setting up this department. It is arranged on a continuous production basis. The work does not "backtrack" at any time.

The curved sections of both the front and rear bumpers, which are manufactured by the methods described in August MACHINERY, are received at one end of the department in the special containers in which they are transferred from the press shop. Here they are loaded on an overhead conveyor of the type seen in Fig. 1 and are carried past booths where a small bracket is arc-welded on the inner side of each bumper part to provide a means of bolting the bumper to the automobile frame. The bumper parts are then replaced on the conveyor by the welders, after which they are carried through the three-stage washing machine shown in Fig. 2, which removes all grease and lubricant remaining from the press operations.

When they leave the washing machine, the bumper parts are transferred by hand to another conveyor line, which carries them past a group of floor type polishing lathes. The operators of these machines remove any surface defects and then replace the bumper parts on the conveyor. Next they are carried to the loading end of a belt conveyor which runs past a long line of polishing machines arranged for the automatic polishing of the bumper parts for one-half their length.

There are seven machines along one side of the conveyor, at one end, which polish the bumpers on one side for half their length. Another group of seven machines on the other side and opposite end of the conveyor polish the bumper parts on the opposite side for the same half of their length. The

and Plating Piece Bumpers



bumpers are mounted on fixtures attached to the belt conveyor, which are adjustable to suit the curved parts of both front and rear bumper sections. Fixtures are interchangeable for front and rear bumper parts.

Close-up views of three of the polishing heads are shown in Figs. 3, 4, and 5. Each wheel contacts the bumper part at its lowest point, and as the bumper is fed beneath the wheel, the latter rises automatically, following the bumper contour to the half way point, where the wheel is automatically raised from contact with the bumper. The wheel then drops into position for polishing the next bumper part. The polishing heads are provided with the necessary counterbalances. They can be conveniently set to any desired height on a post which supports each head. Also, the wheelhead can be swiveled to any required position around 360 degrees.

The polishing heads are set at different angles, so as to polish the entire cross-sectional contour on the outside of the bumper parts. Wheels of 180 grit are used in this operation, together with 80 per cent saponifiable grease stick. One of these grease sticks is mounted on a slide at the left of each polishing wheel, as seen in Figs. 3 and 4, and can be readily advanced into contact with the wheel. The polishing wheels as originally set up are 14 inches in diameter, and they are used down to a diameter of 10 inches.

When the bumper parts reach the unloading end of this straight-line polishing conveyor, they are placed on another overhead conveyor which carries them to a similar group of automatic polishing machines. This group polishes the bumper parts along the second half of their length. Abrasive dust is completely removed from the department by an exhaust system with ducts leading to each polishing wheel.

Incidentally, all polishing wheels used in the department are set up in an adjacent room, and are stored until required in a room that is maintained at a constant temperature and humidity. These atmospheric conditions were determined upon after considerable experimentation. They are such as to keep the glue that holds the abrasive compound to the polishing wheel plastic and insure maximum life of the wheels.

Following the polishing operations, the bumper parts are carried by conveyor through a second washer preparatory to copper-plating and arrive at a racking area at the loading end of the plating unit. Here the parts are attached to racks, which are then suspended from horizontal work-bars of an overhead conveyor. This conveyor extends the full length of the copper-plating installation. The ends of the work-bars ride between sawtooth dogs of the conveyor chain on each side of the installation. The work-bars are not attached to the chains, being free to be dropped at various points onto similar conveyor chains extending along the tops of the tanks in the plating installation. The work-bars are raised and lowered by means of blocks attached to chain-loop transfers on opposite sides of the tanks. The arrangement of these chain-loop transfers and of the sawtooth conveyor dogs is shown in Fig. 7.

Three racks of work are suspended from each

Fig. 1. Hanging Automobile Bumpers, as They Come from the Press Shop, on an Overhead Conveyor at the Beginning of a Series of Polishing and Plating Operations

work-bar for passage through the copper-plating installation. Prior to the copper-plating process, the bumper parts are carried by the conveyor through a third, short washing machine.

When each work-rod has passed through the washer, it is lifted from the upper conveyor by the blocks of the chain-loop transfer and dropped a distance of about 8 feet to the sawtooth dogs of the conveyors arranged along the top of the cleaning and plating tanks on each side. The bumper parts are now lowered into the first of a series of tanks. From then on, the bumper parts are automatically raised and lowered into different tanks and permitted to remain the required length of time in each tank by an ingenious synchronization of the chain-loop transfers with the sawtooth dogs of the upper and lower conveyors. The details of each step of the process are as follows:

1. Wash: *Power Washer,* 10 feet long by 9 feet 6 inches wide by 10 feet 2 inches deep. *Solution,* one-stage, alkali cleaner. *Temperature,* 150 to 160 degrees F. *Time,* 6.6 minutes. *Capacity,* 1800 gallons. *Number of Work-rods in Tank,* 5.

2. Cathodic Electro-Clean: *Tank Size,* 7 feet 2 inches long by 7 feet wide by 8 feet deep. *Solution,* alkali cleaner. *Temperature,* 175 to 195 degrees F. Time, 2.82 minutes. *Amperage,* 50 to 60 amperes per square foot. *Voltage,* 8 to 10 volts. *Capacity,* 4450 gallons. *Number of Work-rods in Tank,* 2. *Number of Anodes in Tank,* 36.

3. Hot-Water Rinse: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* overflowing tap water. *Temperature,* 175 to 195 degrees F. *Time,* 26 seconds. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

4. Anodic Electro-Clean: *Tank Size,* 5 feet long by 7 feet wide by 8 feet deep. *Solution,* alkali cleaner. *Temperature,* 175 to 195 degrees F. *Time,* 1 1/3 minutes. *Amperage,* 50 to 60 amperes per square foot. *Voltage,* 8 to 10 volts. *Capacity,* 3050 gallons. *Number of Work-rods in Tank,* 1. *Number of Anodes in Tank,* 24.

5. Cold Rinse and Spray: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* overflowing cold water. *Temperature,* 60 to 70 degrees F. *Time,* (a) in tank, 26 seconds; (b) under spray, while transferring. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

6. Acid Dip: *Tank Size,* 5 feet 4 inches long by 7 feet wide by 8 feet deep. *Solution,* 10 per cent sulphuric acid. *Temperature,* room. *Time,* 1 1/2 minutes. *Capacity,* 3240 gallons. *Number of Work-rods in Tank,* 1.

7. Cold Rinse: *Tank Size,* 3 feet 10 inches long

by 9 feet 2 inches wide by 8 feet deep. *Solution,* overflowing cold water. *Temperature,* 60 to 70 degrees F. *Time,* (a) in tank, 26 seconds; (b) under spray, while transferring. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

8. Cold Rinse and Spray: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* overflowing cold water. *Temperature,* 60 to 70 degrees F. *Time,* (a) in tank, 26 seconds; (b) under spray, while transferring. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

9. Copper Strike: *Tank Size,* 5 feet long by 1 foot 6 inches wide by 8 feet deep. *Solution,* standard cyanide copper-plating solution. *Temperature,* 135 to 140 degrees F. *Time,* 1 1/3 minutes. *Amperage,* 50 amperes per square foot. *Voltage,* 7 to 9 volts. *Capacity,* 3050 gallons. *Number of Work-rods in Tank,* 1. *Number of Anodes in Tank,* 24.

10. High-speed Copper-Plate: *Automatic Plating Machine,* 44 feet 11 inches long by 10 feet 6 inches wide by 8 feet deep. *Solution,* potassium high-speed copper-plating bath. *Temperature,* 175 to 180 degrees F. *Amperage,* 25 to 30 amperes per square foot. *Voltage,* 1 1/2 to 3 volts. *Capacity,* 27,000 gallons. *Desired Plate Thickness,* 0.0017 inch (unbuffed). *Number of Work-rods in Tank,* 21. *Number of Anodes in Tank,* 300.

11. Recovery Rinse: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* tap water. Level of high-speed copper-plating bath to be maintained by drawing water from this tank. Tap water to be added only to maintain solution level. *Temperature,* 80 to 100 degrees F. *Time,* 26 seconds. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

12. Hot Rinse: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* tap water. *Temperature,* 140 to 160 degrees F. *Time,* 26 seconds. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

Upon the completion of the copper-plating process, the bumper parts are placed in overhead conveyors and taken to straight-line polishing machines similar to those employed for the preliminary polishing of the bumper parts prior to reaching this department. Again, one straight-line installation is employed for buffing the bumpers for one-half their length, and another similar installation for buffing the remaining half. Soft wheels and a Tripoli stick are employed to obtain a bright finish.

Buffing at this stage of the plating eliminates a great deal of additional buffing that would be required after nickel-plating if the bumpers were not buffed at this time. By color buffing after copper-plating, a much brighter nickel finish is automatically obtained. Also, it is only necessary to color buff approximately 5 per cent of the work after nickel-plating.

When the bumper parts have been satisfactorily color buffed, they are automatically degreased and returned by conveyor to the starting end of the nickel-plating installation. The details of the nickel-plating operation are as follows:

1. Electro-Clean: *Tank Size,* 9 feet 2 inches long by 10 feet 6 inches wide by 8 feet deep. *Solution,* alkali cleaner. *Temperature,* 185 to 195 degrees F. *Time,* 4.25 minutes. *Amperage,* 35 to 45 amperes

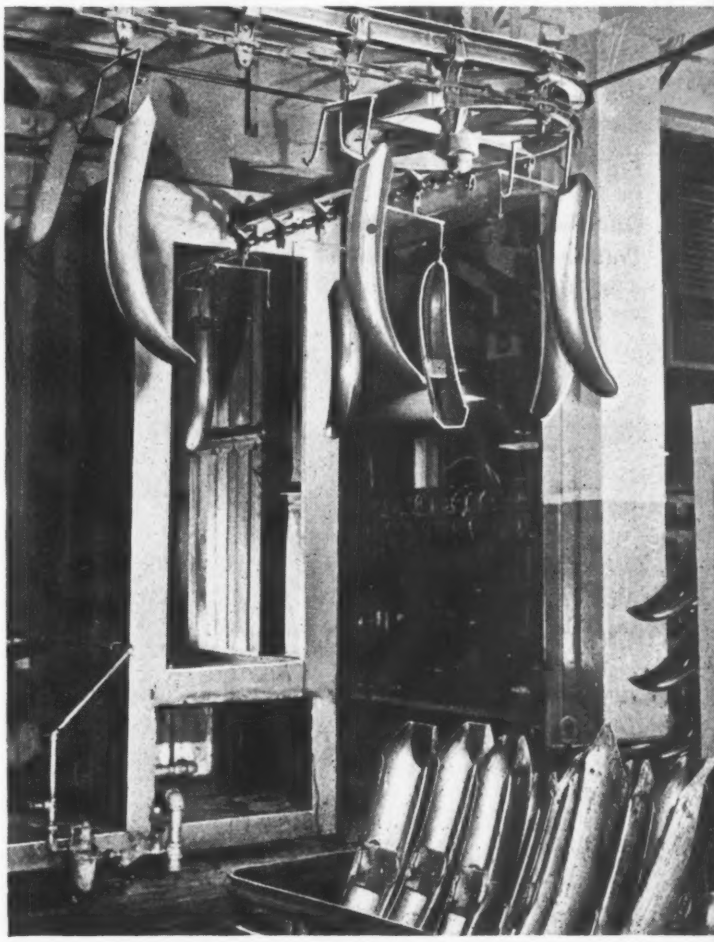


Fig. 2. Three-stage Washing Machine in which All Grease and Lubricant Remaining on the Bumpers after Press Operations are Removed

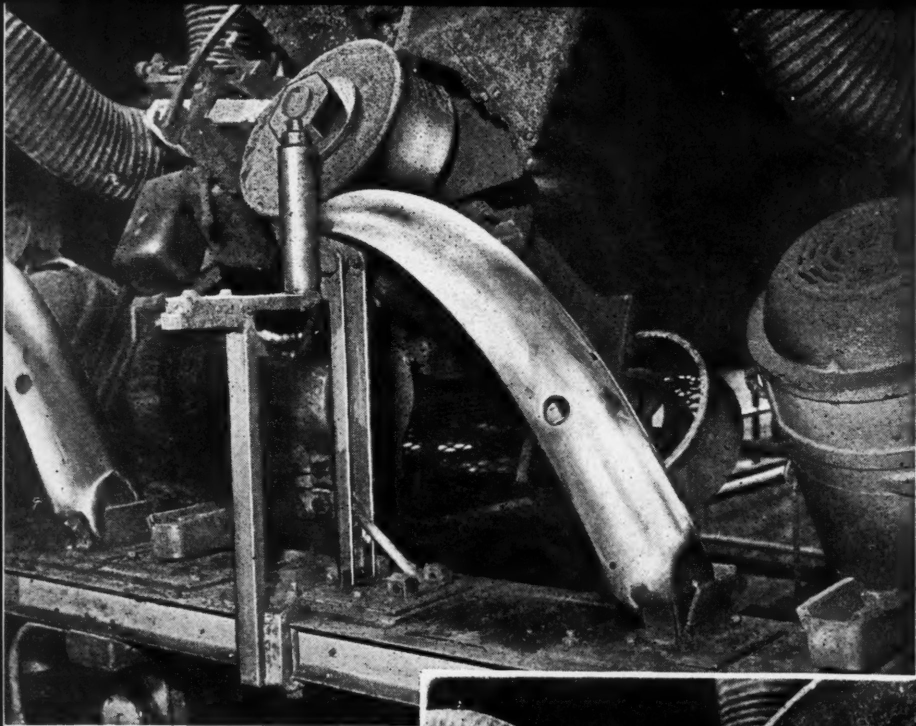


Fig. 3. Close-up View of One of the Machines in a Battery of Seven Arranged in a Line for a Polishing Operation on Front Bumper Pieces

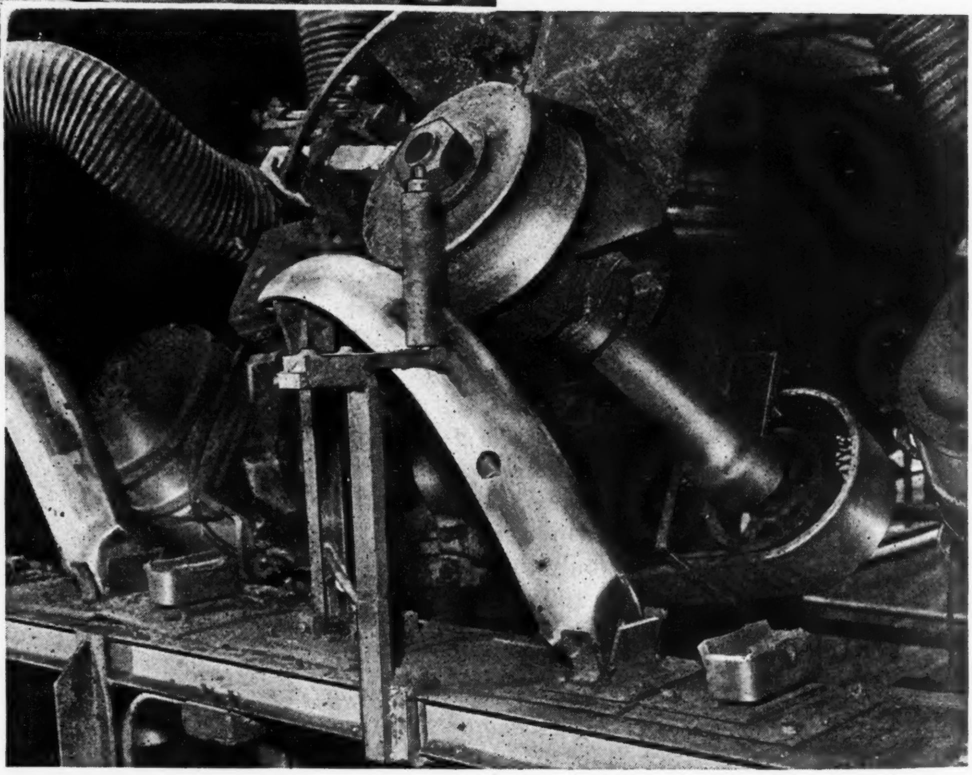


Fig. 4. Polishing Machine in the Same Line as the One Seen in Fig. 3, which Polishes Another Section of the Bumper Part

per square foot. *Voltage,* 9 to 10 volts. *Capacity,* 5600 gallons. *Number of Anodes in Tank,* 36. *Number of Work-rods in Tank,* 3.

2. Cold Spray Rinse: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* spraying cold water. *Temperature,* 60 to 80 degrees F. *Time,* (a) in tank, 26 seconds; (b) under spray, 26 seconds. *Number of Work-rods,* 1.

3. Cyanide Dip (Cathodic): *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* sodium cyanide, 6 to 8 ounces per gallon of water. *Temperature,* room. Time, 26 seconds. *Amperage,* 20 to 25 amperes per square foot. *Voltage,* 7 to 9 volts. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

4. Copper Strike: *Tank Size,* 4 feet long by 10 feet 6 inches wide by 8 feet deep. *Solution,* standard cyanide copper-plating solution. *Temperature,* 135 to 145 degrees F. *Time,* 32 seconds. *Amperage,* 35 to 45 amperes per square foot. *Voltage,* 6 to 8 volts. *Capacity,* 2400 gallons. *Number of Anodes in Tank,* 28. *Number of Work-rods in Tank,* 1.

5. Cold Rinse: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,*

overflowing tap water. *Temperature,* 60 to 80 degrees F. *Time,* 26 seconds. *Capacity,* 2050 gallons. *Number of Work-Rods in Tank,* 1.

6. Cold Rinse and Spray: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* overflowing cold water. *Temperature,* 60 to 80 degrees F. *Time,* (a) in tank, 26 seconds; (b) under spray, while transferring. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

7. Bright Nickel Plate: *Automatic Plating Machine,* 26 feet 10 inches long by 10 feet 6 inches wide by 8 feet deep. *Solution,* bright cobalt nickel bath. *Temperature,* 145 to 155 degrees F. *Time,* 17 minutes. *Amperage,* 45 amperes per square foot. *Voltage,* 6 to 9 volts. *Capacity,* 16,000 gallons. *Desired Plate Thickness,* 0.0006 inch (color buffed). *Number of Work-rods in Tank,* 12. *Number of Anodes in Tank,* approximately 450.

8. Cold Rinse: *Tank Size,* 3 feet 10 inches long by 9 feet 2 inches wide by 8 feet deep. *Solution,* overflowing cold water. *Temperature,* 60 to 80 degrees F. *Time,* 26 seconds. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

9. Hot Rinse: *Tank Size,* 3 feet 10 inches long

Fig. 5. Another Polishing Machine Operating on Front Bumper Pieces at a Station Farther along the Line than Those Shown in Figs. 3 and 4

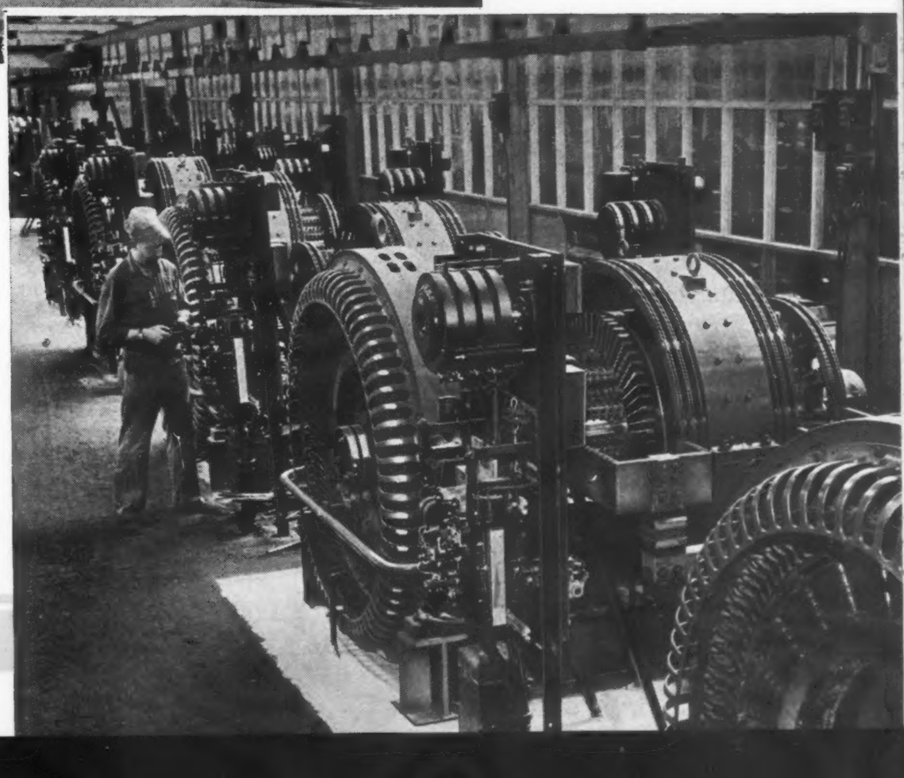


Fig. 6. General View of the Generator Room which Supplies Electrical Current for the Series of Electroplating Operations

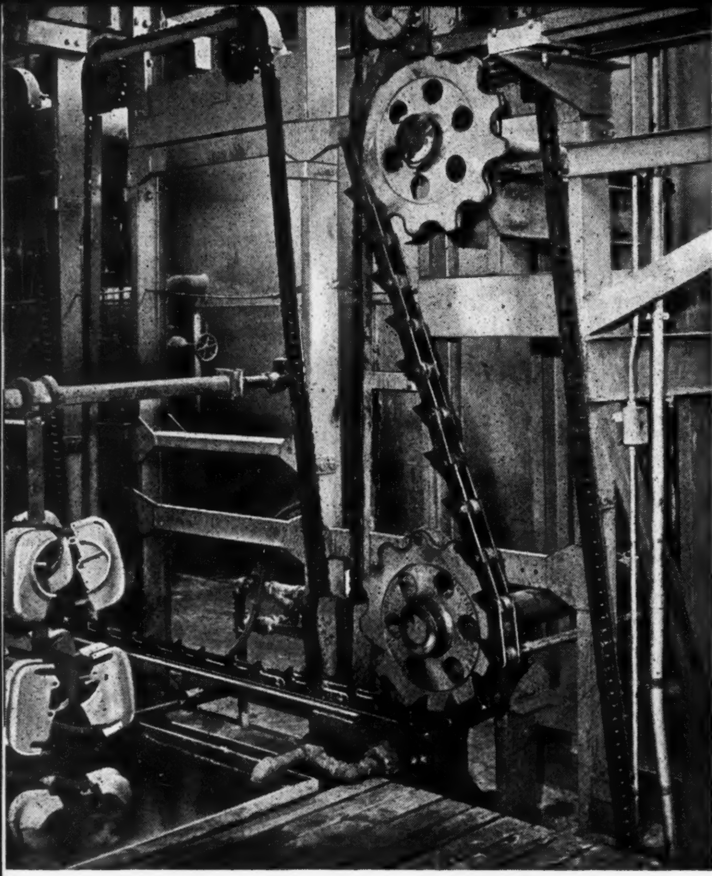


Fig. 7. View of One of the Toothed-dog Conveyor Chains which Carry the Bars of Work through Electroplating Baths, and of the Chain-loop Transfers that Raise the Bars of Work in Transferring Them from Tank to Tank

by 9 feet 2 inches wide by 8 feet deep. *Solution,* overflowing hot water. *Temperature,* 140 to 160 degrees F. *Time,* 26 seconds. *Capacity,* 2050 gallons. *Number of Work-rods in Tank,* 1.

10. Color Buff: *Nine Lathes. Compound,* nickel buffing compound.

As the bumpers come from the nickel-plating installation, they are carefully inspected and all parts requiring buffing are routed to hand polishing lathes. Those parts that do not require buffing and those that have been buffed are next suspended on work racks for passage through the chromium-plating tanks. This step of the process is carried out with equipment similar to that employed for the copper-plating and nickel-plating operations. The details of chromium-plating are as follows:

1. Wash: *Power Washer,* 12 feet long by 6 feet 6 inches wide by 10 feet 2 inches deep. *Solution,* alkali cleaner. *Temperature,* 150 to 160 degrees F. *Time,* 4.4 minutes. *Capacity,* 1500 gallons. *Number of Work-rods in Tank,* 5.

2. Cathodic Electro-Clean: *Tank Size,* 8 feet 3 inches long by 7 feet 6 inches wide by 8 feet deep. *Solution Formula,* T.S.P., 4 ounces per gallon of water; and caustic soda, 0.5 ounce per gallon of water. *Temperature,* 125 to 150 degrees F. *Time,* 1.92 minutes. *Amperage,* 30 to 40 amperes per square foot. *Voltage,* 8 to 9 volts. *Capacity,* 3550 gallons. *Number of Work-rods in Tank,* 2. *Number of Anodes in Tank,* 27.

3. Cold Rinse and Spray: *Tank Size,* 3 feet 10 inches long by 6 feet 2 inches wide by 8 feet deep. *Solution,* overflowing cold water. *Temperature,* 60 to 80 degrees F. *Time,* (a) in tank, 26 seconds; (b) under spray, while transferring. *Capacity,* 1350 gallons. *Number of Work-rods in Tank,* 1.

4. Acid Dip: *Tank Size,* 4 feet 1 inch long by 7 feet 6 inches wide by 8 feet deep. *Solution,* sulphuric acid, 3 to 4 per cent by volume. *Temperature,* room. *Time,* 20 seconds. *Capacity,* 1775 gallons. *Number of Work-rods in Tank,* 1.

5. Cold Rinse and Spray: *Tank Size,* 3 feet 10 inches long by 6 feet 2 inches wide by 8 feet deep. *Solution,* overflowing tap water. *Temperature,* 60 to 80 degrees F. *Time,* 14 seconds. *Capacity,* 1350 gallons. *Number of Work-rods in Tank,* 1.

6. Cold Rinse and Spray: Tank size, 3 feet 11 inches long by 6 feet 2 inches wide by 8 feet deep. *Solution,* overflowing tap water. *Temperature,* 60 to 80 degrees F. *Time,* 14 seconds. *Capacity,* 1400 gallons. *Number of Work-rods in Tank,* 1.

7. Chromium Plate: *Automatic Plating Machine,* 17 feet 7 inches long by 7 feet 7 inches wide by 8 feet deep. *Solution,* standard chromic-acid plating solution. *Temperature,* 120 degrees F. *Time,* 5 minutes. *Amperage,* 165 to 175 amperes per square foot. *Voltage,* 9 to 12 volts. *Capacity,* 7300 gallons. *Number of Work-rods in Tank,* 6. *Number of Anodes in Tank,* 80.

8. Reclaim Rinse: *Tank Size,* 3 feet 11 inches long by 6 feet 2 inches wide by 8 feet deep. *Solution,* tap water. *Temperature,* 80 to 100 degrees F. *Time,* 14 seconds. *Capacity,* 1400 gallons. *Number of Work-rods in Tank,* 1.

9. Cold Rinse: *Tank Size,* 3 feet 10 inches long by 6 feet 2 inches wide by 8 feet deep. *Solution,* overflowing tap water. *Temperature,* 60 to 80 degrees F. *Time,* 14 seconds. *Capacity,* 1350 gallons. *Number of Work-rods in Tank,* 1.

10. Hot Rinse: *Tank Size,* 4 feet 7 inches long by 6 feet 2 inches wide by 8 feet deep. *Solution,* overflowing heated tap water. *Temperature,* 140 to 160 degrees F. *Time,* 31 seconds. *Capacity,* 1600 gallons. *Number of Work-rods in Tank,* 1.

When the bumper parts leave the chromium-

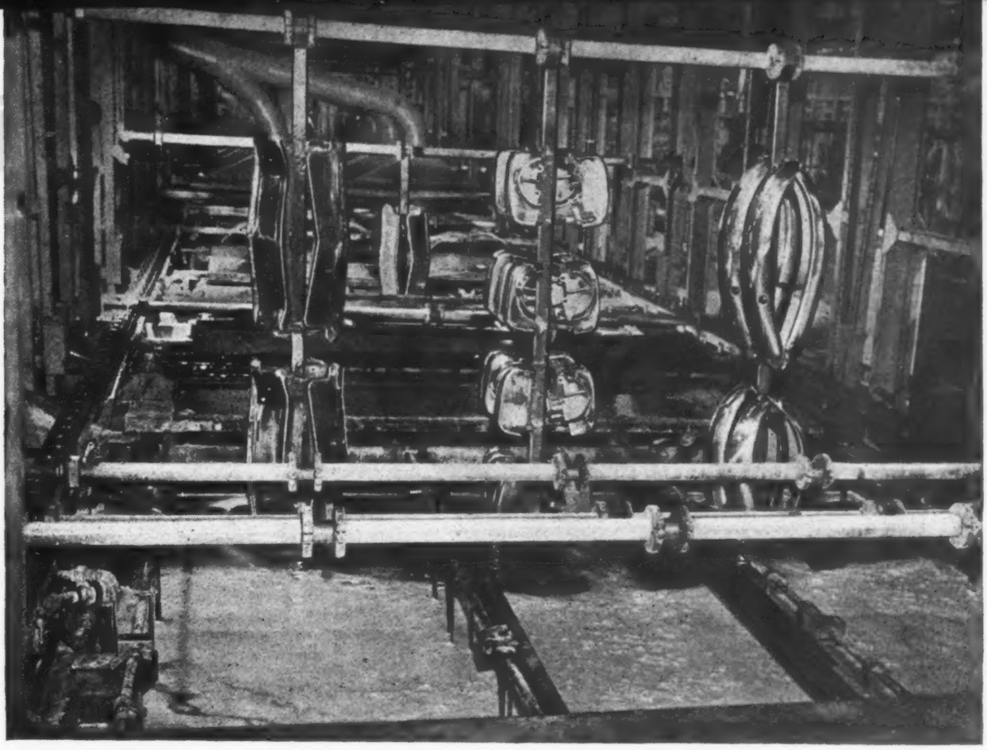


Fig. 8. View Showing Work in Various Stages of One of the Three Electroplating Processes, there being Three Similar Units for Copper, Nickel, and Chromium Plating

plating bath, they are once more inspected carefully, and parts that require buffing are carried by overhead conveyors to three polishing lathes.

The plating, cleaning, and stripping generators and other electrical equipment required for the electroplating department (Fig. 6) are installed in a glass-enclosed room adjacent to the plating units. There are twenty-five generators ranging in capacity from 1500 to 7500 amperes.

In the event that it becomes necessary to remove plating from bumper parts, use is made of three different baths, depending upon the metal to be stripped, as follows:

For Stripping Copper from the Base Metal: *Solution*, strip salts. *Temperature*, 80 to 100 degrees F. *Time*, approximately 30 minutes per 0.001-inch thickness of copper plate. *Amperage*, 25 to 30 amperes per square foot (anodic). *Voltage*, 8 to 10 volts. *Capacity*, approximately 1000 gallons working capacity. *Number of Anodes in Tank*, 16.

For Stripping Nickel from Copper-plated Surfaces: *Solution*, 66 Baumé sulphuric acid. *Temperature*, 80 to 85 degrees F. *Time*, approximately 1 hour per 0.001-inch thickness of plate. *Amperage*, 25 to 30 amperes per square foot (anodic). *Voltage*, 12 volts. *Capacity*, 1000 gallons working capacity. *Number of Anodes in Tank*, 10 steel anodes.

For Stripping Chromium Plate from Nickel-plated Surfaces: *Solution*, caustic soda. *Temperature*, 150 degrees F. *Time*, 15 minutes for 0.000020-inch thickness of plate. *Amperage*, 30 to 35 amperes per square foot (anodic). *Voltage*, 12 volts. *Capacity*, approximately 1000 gallons working level. *Number of Anodes in Tank*, 10 steel anodes.

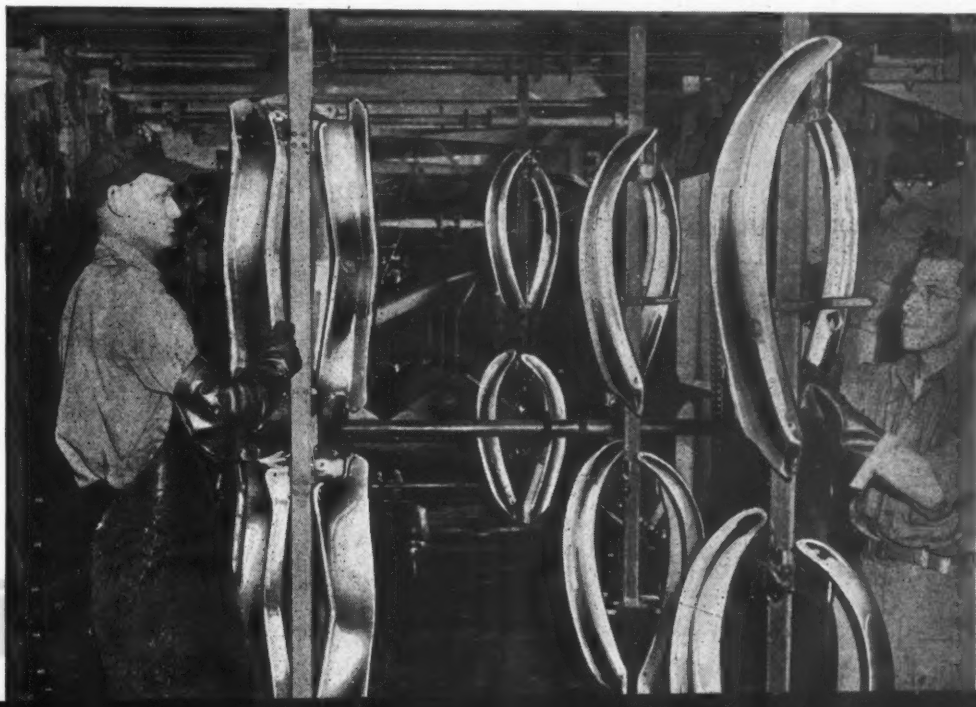
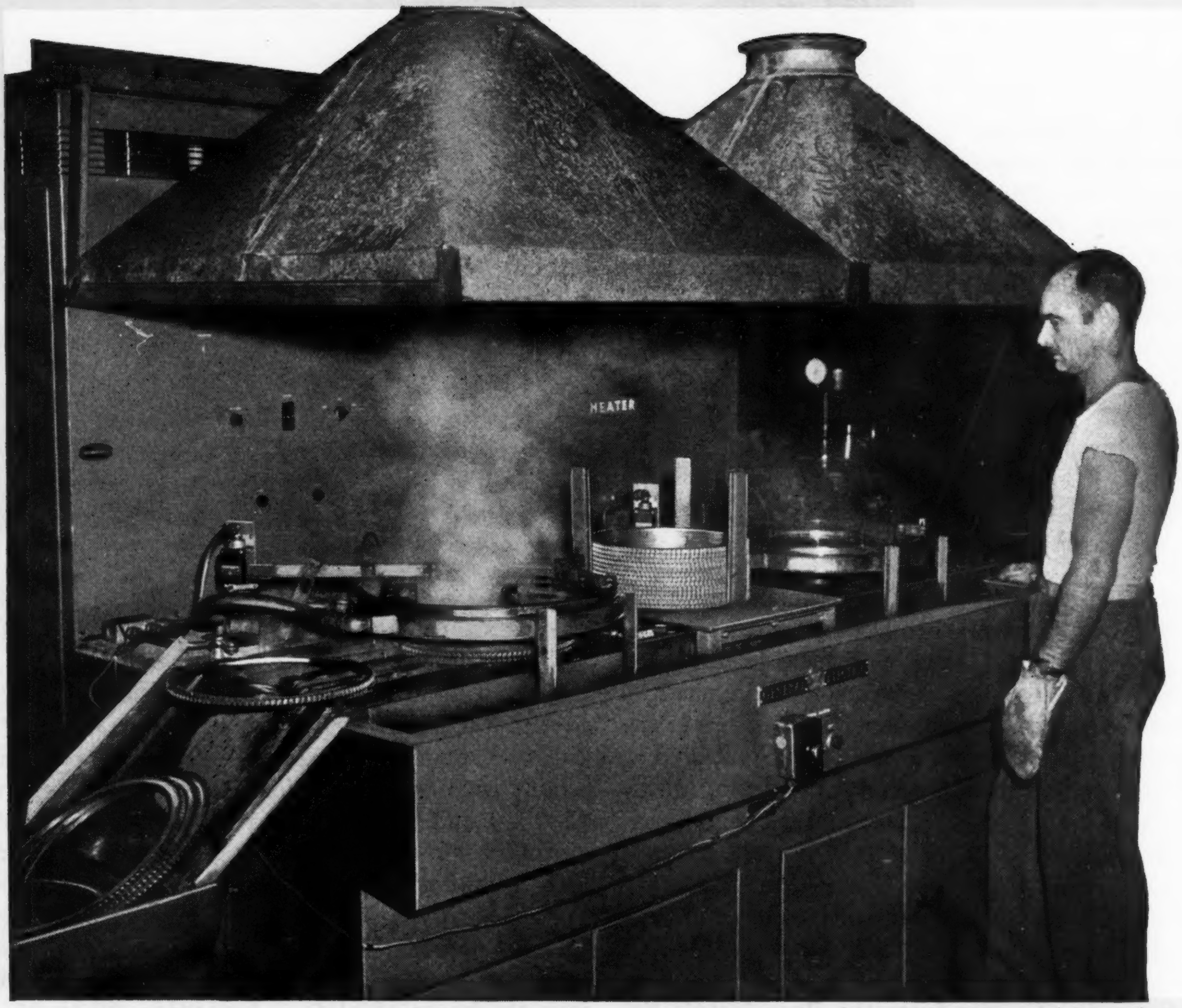


Fig. 9. Inspecting the Chromium-plated Bumper Parts after They Leave the Chromium-plating Baths and are Ready for Delivery to Oldsmobile Assembly Lines



INDUCTION heating possesses advantages that will be increasingly utilized in metal-working plants. One of the outstanding features of this process is, of course, the ability to heat locally, so that a part can be hardened in sections that must withstand wearing action and be left soft at all other points where hardness is not a primary requirement or where ductility is more desirable than strength.

Another advantage of induction heating is that a part can be permanently expanded by being heated to about 1500 degrees F. and then allowed to cool. A shaft, say 2 inches in diameter, can be readily expanded by this method as much as 0.002 or 0.004 inch. This fact opens the door for the salvaging of many parts that have been ground under size or worn small in service.

An outstanding application of induction heating in the Rouge plant of the Ford Motor Co. is the completely automatic hardening of starter ring gears at the rate of three gears per minute per machine. This means a possible production by one machine of 180 ring gears an hour. These gears have an inside diameter of 12 3/8 inches, and are made with 112 teeth of 8-10 pitch and a 20-degree pressure angle. The gears are 3/8 inch thick and are produced from Ford "EEEE" steel corresponding with S A E 1045 specification. The teeth are hardened in their full cross-section to about 1/8 inch below the root diameter to approximately 56 to 60 Rockwell C, the hardness of the body not being affected by this operation.

The gears are then heated on the inside diameter in a 960-cycle induction heater to expand them previous to shrinking them on the flywheels. This heater expands the inside diameter of the gears enough to slip them on the flywheel, and also draws the teeth to a hardness of 48 to 52 Rockwell C.

Automatic Induction Hardening of Ford Starter Ring Gears

An Outstanding Application of the Induction Heating Process, by Means of which One Hundred Eighty Ring Gears can be Automatically Hardened per Machine per Hour

By CHARLES O. HERB

Previously, the gears were heated in a furnace and hardened all over. After quenching, they were drawn to 35-40 Rockwell C hardness to provide a ductile body. However, in so doing, the hardness of the teeth was also reduced. By induction hardening it is possible to produce gears with a soft body and a high tooth hardness, and these gears give 150 per cent longer service life.

The heading illustration shows one of two electronic induction heaters arranged for the automatic handling of these starter ring gears. It will be seen that a combination heating and quenching unit is provided on each end of the machine, so that two gears can undergo the hardening process alternately. A hopper in which the gears are stacked prior to hardening is located between the two heating and quenching units. A close-up view of these units and the hopper is shown in Fig. 1.

Transfer of the gears from the hopper to either heating and quenching unit is effected through a hydraulically actuated slide which is alternately moved to the left and to the right for supplying both units with unhardened gears and ejecting hardened gears from the machine. This slide is cut to a semicircular outline on each side of the same radius as the gears.

The slide advances against the gear to be loaded in either fixture until the gear to be loaded in either fixture until the gear is fitted snugly within the corresponding slide contour. Then, as the slide continues its movement, the gear is carried along with it until the gear reaches the center of a dial provided on each heating and quenching unit. This dial is depressed at the time of loading, as may be seen in Fig. 2, which shows a hardened gear being discharged at the left by the hydraulic slide and a new gear being advanced at the right.

When the gear reaches the center of the dial, the

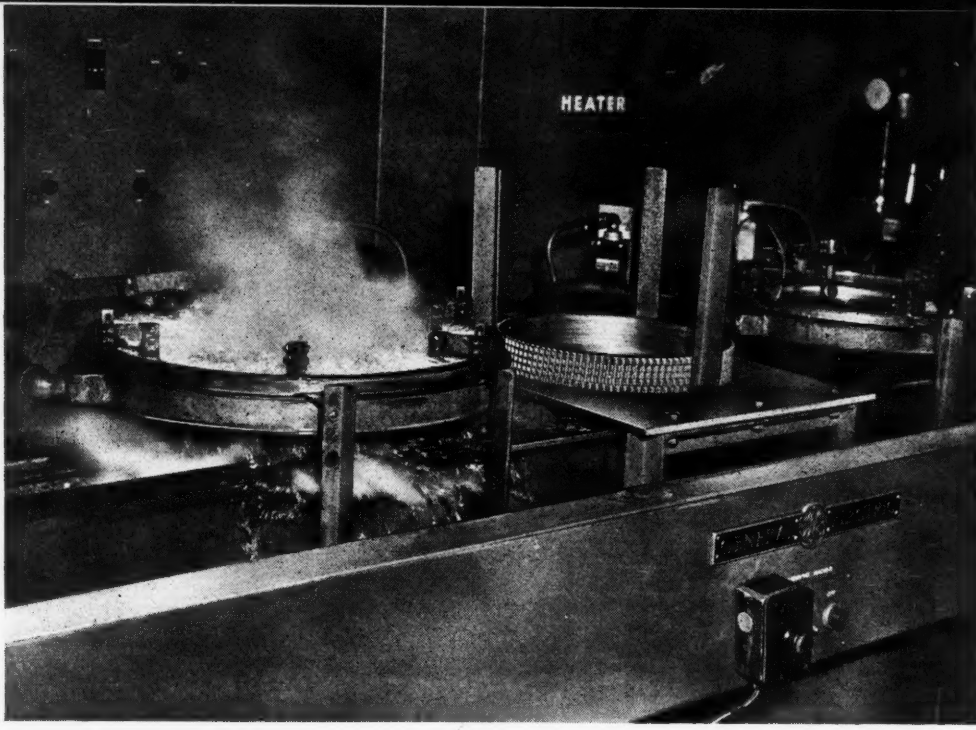


Fig. 1. The Two Heating and Quenching Stations and the Loading Magazine of the Electronic Heater Used for the Induction Hardening of Starter Ring Gears at the Rouge Plant of the Ford Motor Co.

hydraulic slide returns to the right to reload the right-hand heating and quenching unit. As soon as the slide clears the left-hand unit, the circular dial on which the gear rests is raised automatically into the position shown in Fig. 3. This brings the gear into the same horizontal plane as the heating coil that extends around the unit just outside the periphery of the gear. The dial then automatically starts rotating at about 90 R.P.M., continuing for a period of twenty seconds, during which the temperature of the gear teeth is raised to approximately 1500 degrees F. When electrical current is passing through the coils, there is a red light on the machine, so that the operator knows definitely that the equipment is functioning properly.

The dial and work are automatically rotated when the dial is lifted into contact with a roller attached to an arm that extends over the dial from a bracket at the rear of the machine. When the roller is lifted, the front end of the arm swings upward, while the opposite end is lowered to trip a switch that starts the motor.

At the end of twenty seconds, the heat is turned off by a timer switch, and with the gear still revolving, water is directed on the gear teeth through a large number of jets in a ring that surrounds the revolving dial and gear, as seen in Fig. 4. The sprays, which are directed through 520 holes of 0.060 inch diameter, remain turned on for four seconds. At the end of this period, the work dial moves downward into the reloading position. Rotation of the dial and work ceases as soon as the dial drops out of contact with the roller, so that the dial is stationary during unloading and reloading.

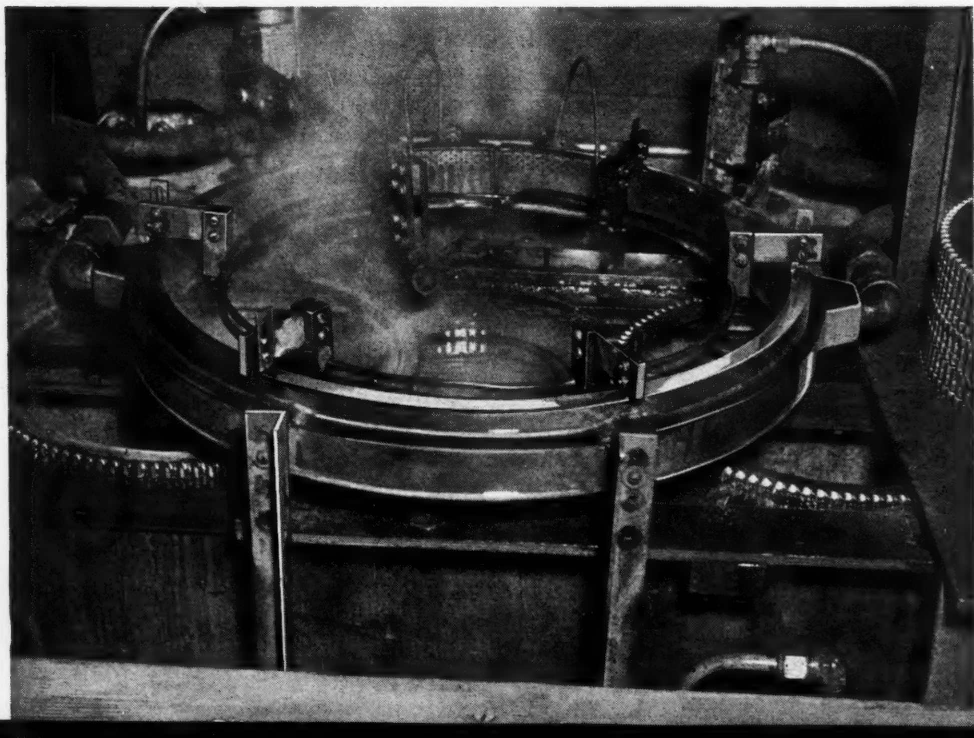


Fig. 2. Close-up View of One of the Heating and Quenching Stations Taken at a Time when a Hardened Gear was being Removed from the Work Dial and a New Gear Loaded on the Dial

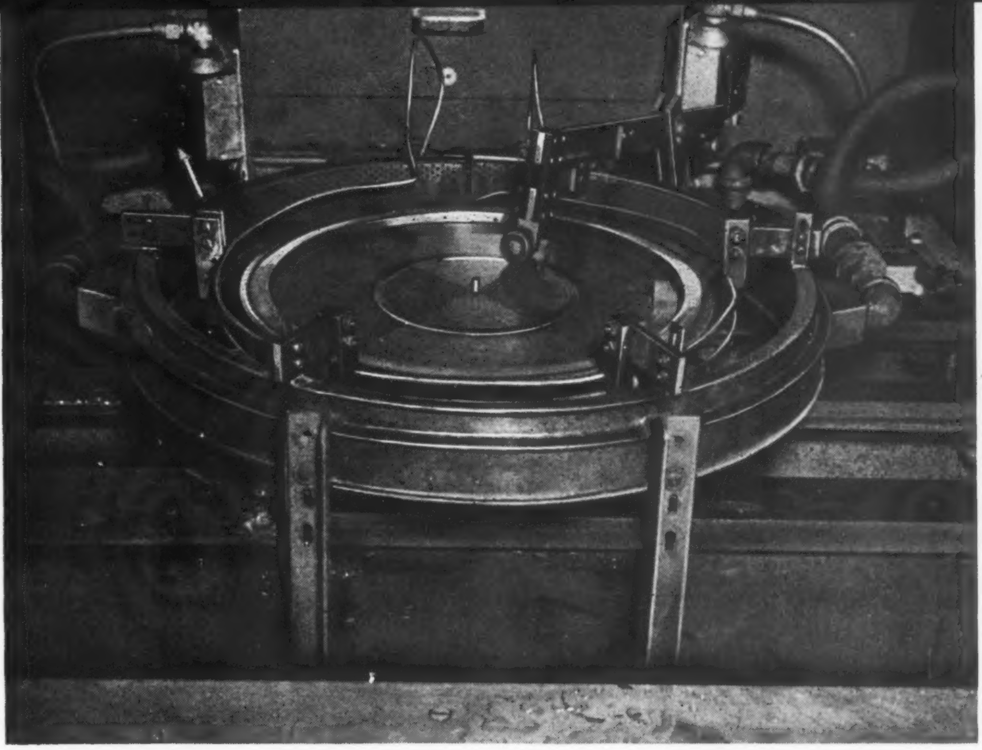


Fig. 3. During the Heating Period, Each Starter Ring Gear is Revolved on a Dial with the Gear in the Same Horizontal Plane as the Heating Coil, the Quenching Ring being Located Outside of the Coil

Conveyors are to be installed for automatically carrying the hardened gears away from the machine and to subsequent operations.

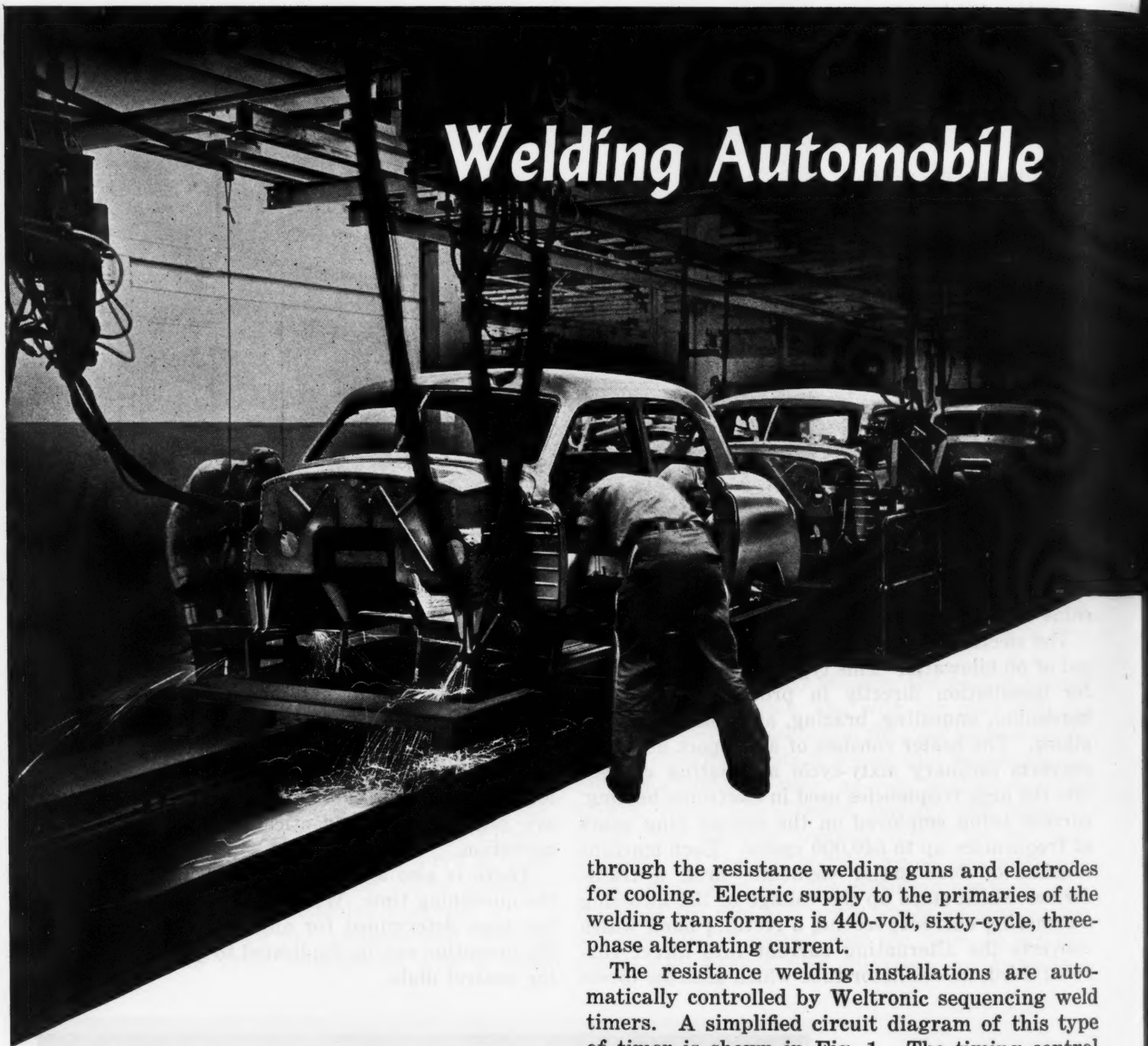
The electronic induction heater provides an output of 50 kilowatts. This type of heater is suitable for installation directly in production lines for hardening, annealing, brazing, and soldering operations. The heater consists of a compact unit that converts ordinary sixty-cycle alternating current into the high frequencies used in electronic heating, current being employed on the starter ring gears at frequencies up to 540,000 cycles. Each machine consists of four major elements—first, a transformer which steps up the voltage of the incoming alternating current; second, a rectifier bank which converts the alternating current into direct current; third, an oscillator tube which uses the direct current to generate high-frequency alternating current; and fourth, an assortment of heating coils which form a part of the oscillating circuit and transfer heat energy to the work.

With this equipment, it is possible to govern within a fraction of a second the length of time the heat is applied to the work, so that it will not spread to other areas by conduction. The automatic timing device which controls the heating period is located within the cabinet. Once the control dials are set, heating is identical in each subsequent operation.

There is also a suitable control in the unit for the quenching time. When the length of quenching has been determined for any given type of work, the operation can be duplicated by properly setting the control dials.

Fig. 4. View of the Right-hand Hardening Station Photographed when Water for Quenching the Heated Gear is being Sprayed through More than 500 Small-diameter Jets

Welding Automobile



ALL-STEEL bodies with rigid box type frames are a feature of the Frazer and Kaiser "Special" automobiles. These bodies are of a conventional but intricate design, which necessitates the use of special fixtures and machines for welding sub-assemblies. Some of the more outstanding of these operations performed at the Willow Run plant will be described in this article.

An unusually high air-line pressure of 105 pounds per square inch exists in this plant. This pressure is reduced to 45 pounds per square inch by individual air regulators on each resistance welding gun and machine. A line water pressure of 78 pounds per square inch is reduced to 35 pounds per square inch before it is circulated through the resistance welding guns and electrodes for cooling. Electric supply to the primaries of the welding transformers is 440-volt, sixty-cycle, three-phase alternating current.

The resistance welding installations are automatically controlled by Weltronic sequencing weld timers. A simplified circuit diagram of this type of timer is shown in Fig. 1. The timing control can be divided into six functional circuits: One for energizing the air-valve solenoid on the welding gun or machine; a second for limiting the "squeeze" period during which the electrodes are clamped to the work; a third for timing the weld current to the electrodes; a fourth for releasing the electrodes from the work after a preset time; a fifth for regulating off time; and a sixth for contactor control. These circuits are shown blocked off and designated in the circuit diagram.

Only one relay—that shown at R in the air-valve solenoid circuit—is used in this type of timer. Miniature thyratron tubes are employed in place of the usual sequencing relays. Two of these tubes and two larger thyratrons are used in the contactor control circuit for the direct firing of the ignitors

Bodies at Kaiser-Frazer's Willow Run Plant

By CHARLES H. WICK

The All-Steel Bodies of the New Kaiser and Frazer Automobiles are Assembled by Spot-Welding with Portable Hand-Operated Guns and Automatic Machines, as Well as by Gas- and Arc-Welding Operations

in the ignitron contactor, thus eliminating the need for a firing relay.

Closing of the initiating switch *S*, shown at the left, completes the circuit to relay *R* through the transformer *T* and two thyratron tubes in the valve and lock-in circuits. Contact *B* of the relay closes and shunts the switch which locks in this circuit, thus causing the timer to continue the weld sequence even if the pressure on the switch is released. Contact *A* closes simultaneously and allows the air-valve solenoid to become energized, thus clamping the electrodes of the welder to the work.

The same initiating action starts the "squeeze" period. When the time set for the "squeeze" period has elapsed, the contactor control circuit operates to allow the ignitron contactor to initiate the weld current. After a preset time, the contactor control circuit is blocked and the weld terminates. The hold time is initiated at this point. When this time has elapsed, one of the tubes in the valve and lock-in circuits is blocked, thus de-energizing the air-valve solenoid and releasing the electrodes from the work. If the initiating switch is open at this point, the single weld operation will be completed. However, if the initiating switch remains closed, the cycle will repeat itself after the preset off time has expired.

No definite time can be specified for squeeze, weld, hold, or off cycles for welding together any two thicknesses of metal. Many variables, such as the size of the electrode and the cleanliness and fit of the parts, affect these cycles, and each set-up must be determined by making experimental welds.

Graduations on the control panel of the sequencing weld timers permit the setting of each cycle at from 3 to 60 seconds. There is an alternate range for settings of from 60 to 120 seconds. A power transformer on the timer, with three secondary windings, changes the 440-volt power source to 100 volts for power in the control circuit, 6 volts for heater current to all tubes, and 24 volts for the pilot circuit when required.

Hat-section channel reinforcements of 14-gage mild steel are spot-welded to the under side of the 18-gage mild-steel front floor pan by means of the Federal automatic resistance welding machine shown in Fig. 2. Four of these reinforcements are nested in copper channels in the base of the welding machine and the floor pan is placed on top of them. Four transformers, each having a capacity of 75 KVA, and eight water-cooled electrodes—two on each of the four welding heads—are used on this machine.

Approximately forty-four spot-welds are made on each reinforcement. This is accomplished by raising the electrodes, traversing the heads to right or left, and lowering the electrodes by means of pneumatic cylinders. Each of the four air tanks shown mounted on the machine supplies air to one head with its two electrodes.

At certain locations on the work, it is necessary to restrict the number of simultaneous welds to four or six because of obstructions on the surface of the floor pan. This control of the number of welds is accomplished by means of cams mounted in the upper left-hand corner of the machine. The

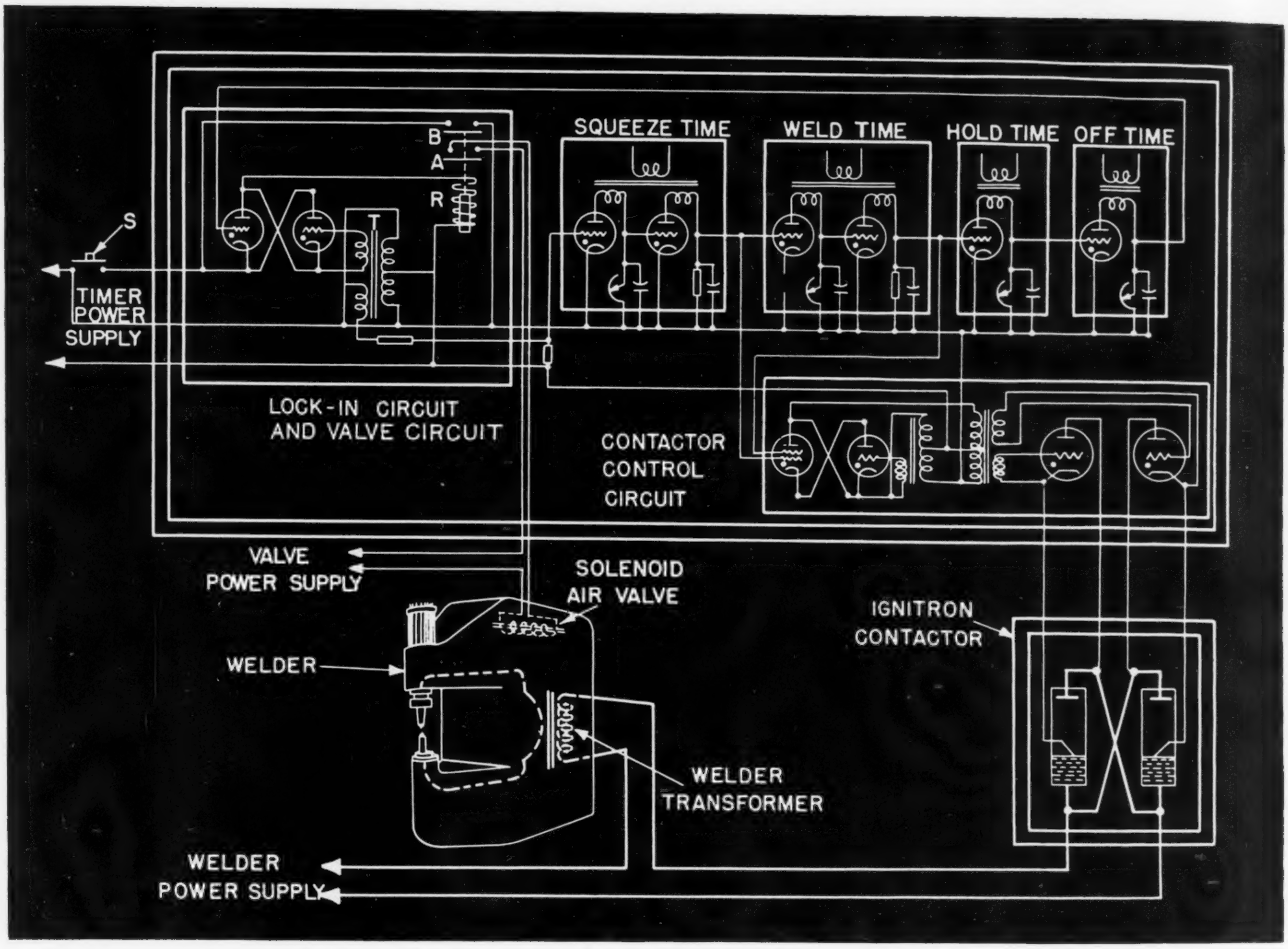


Fig. 1. Simplified Circuit Diagram of the Weltronic Sequencing Weld Timer that is Used to Automatically Control the Resistance Welding Operations

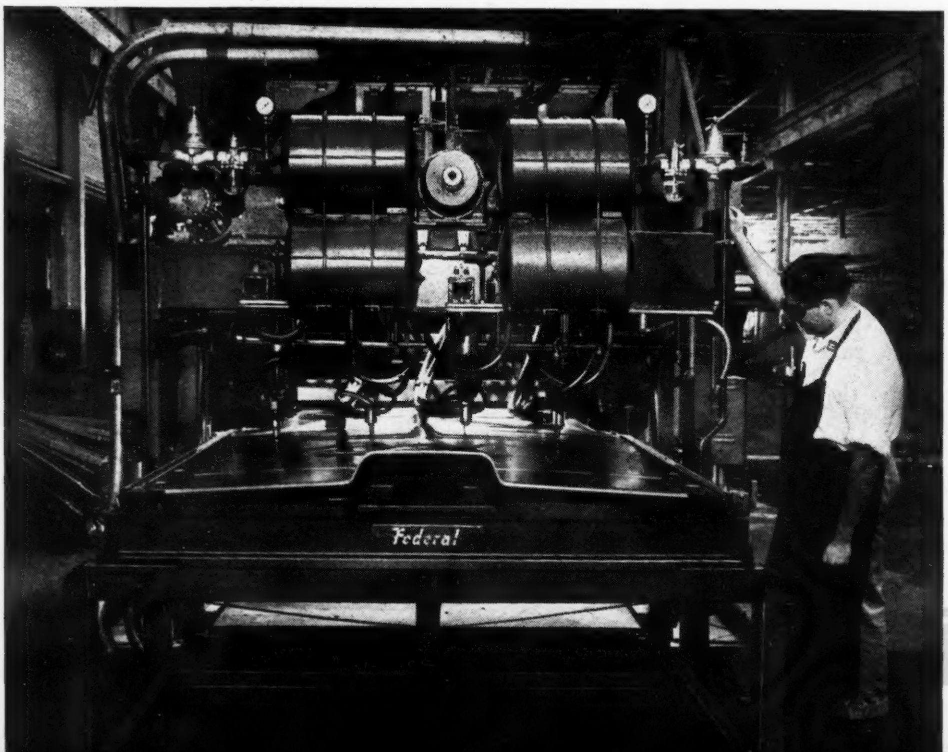


Fig. 2. Automatic Resistance Welding Machine which is Used to Join Fourteen-gage Reinforcements to Under Side of Eighteen-gage Floor Pans

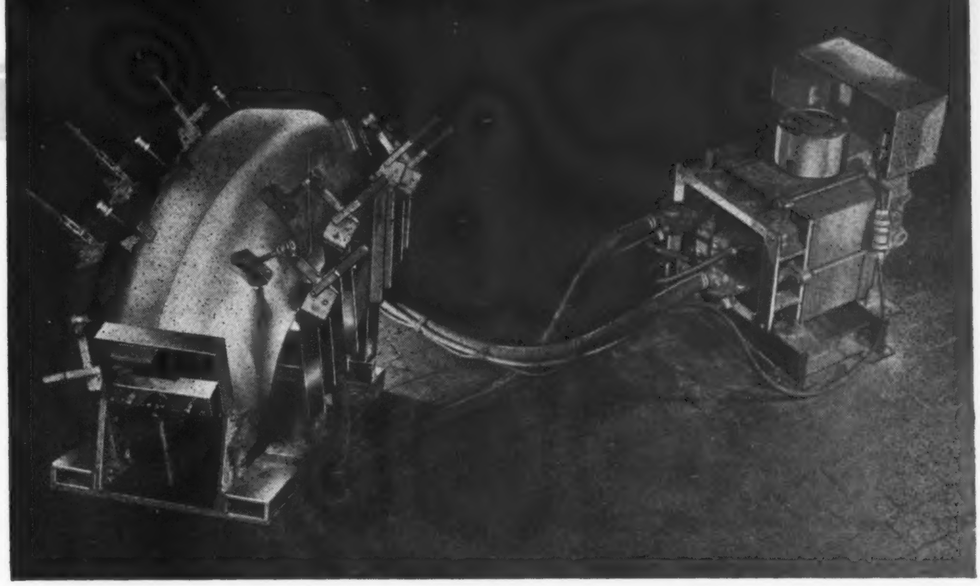


Fig. 3. Welding Fixture in which the Current Passes from the Electrode of a Hand-operated Short-circuiting Gun, through Work, and to Fixture

welding cycles are controlled by the electronic timer previously described.

Examples of temporary fixtures used for hand-gun welding, which were designed and built to obtain immediate production, are shown in Figs. 3 and 4. These simple fixtures will, in most cases, be replaced by automatic welding machines, in which most of the spot-welds will be made simultaneously. Sub-assemblies welded with hand-guns in these fixtures are usually made from 16- to 20-gage mild steel. The parts are clamped in welding position in the fixtures by quick-acting clamps with wooden blocks that are formed to the same contour as the work.

A Martin spade-handle, short-circuiting, spot-welding gun is used for the set-up shown in Fig. 3. This gun is of the hand-operated, portable type. The welding current from the secondary of the 75-KVA transformer shown at the right passes from the single electrode of the hand-gun through the overlapped mild steel edges of the parts, into the copper-conducted back-up bar of the fixture, and back to the transformer. By using as few clamps as possible and placing them in positions not requiring welding, the quarter-panel sub-assemblies of an automobile body can be completely spot-welded by the set-up shown in Fig. 4.

Four halves are assembled into two center pillars in each cycle of a Taylor-Winfield flash-butt welder. The approach of the pillar halves to be welded is effected by means of a low-pressure hydraulic cylinder, and the final push at the instant of welding is accomplished by means of accumulators that momentarily deliver large quantities of oil at high pressure.

An excellent example of the high-production automatic welding presses that will replace the hand-welding guns now being used for many operations is shown in Fig. 5. Such automatic spot-welding machines are especially adaptable to automotive production because of their versatility. Removable dies are designed for welding specific sub-assemblies, while the four-post press is standard, and can be used with various dies.

Individual, small welding transformers, each having capacity for four electrodes, are placed adjacent to the various spot-welding electrodes. This eliminates the use of a large transformer and secondary distributors, and permits the use of short, equal welding cables, thus equalizing the welding

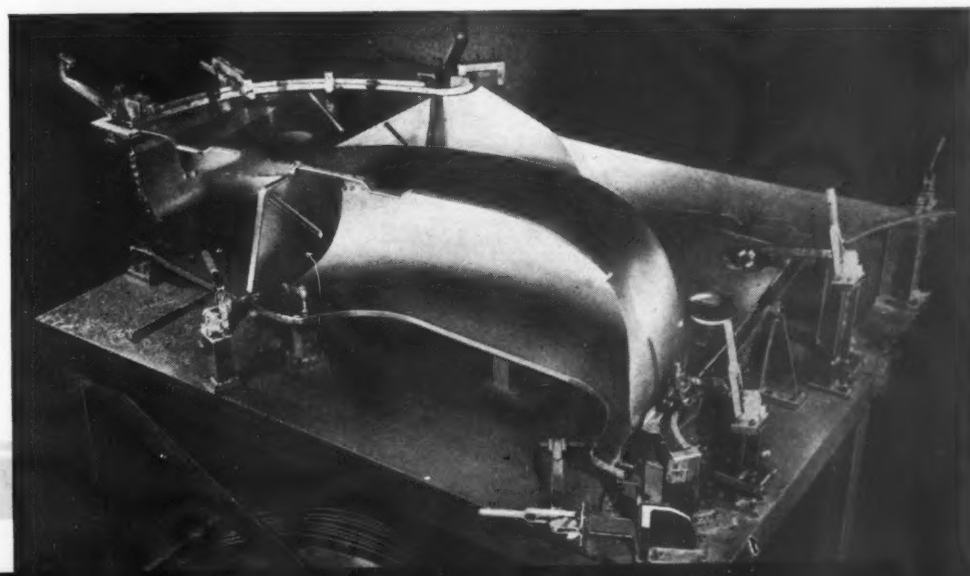


Fig. 4. A Simple Fixture for Clamping the Quarter-panel Assembly of an Automobile Body while Spot-welding with a Hand-gun

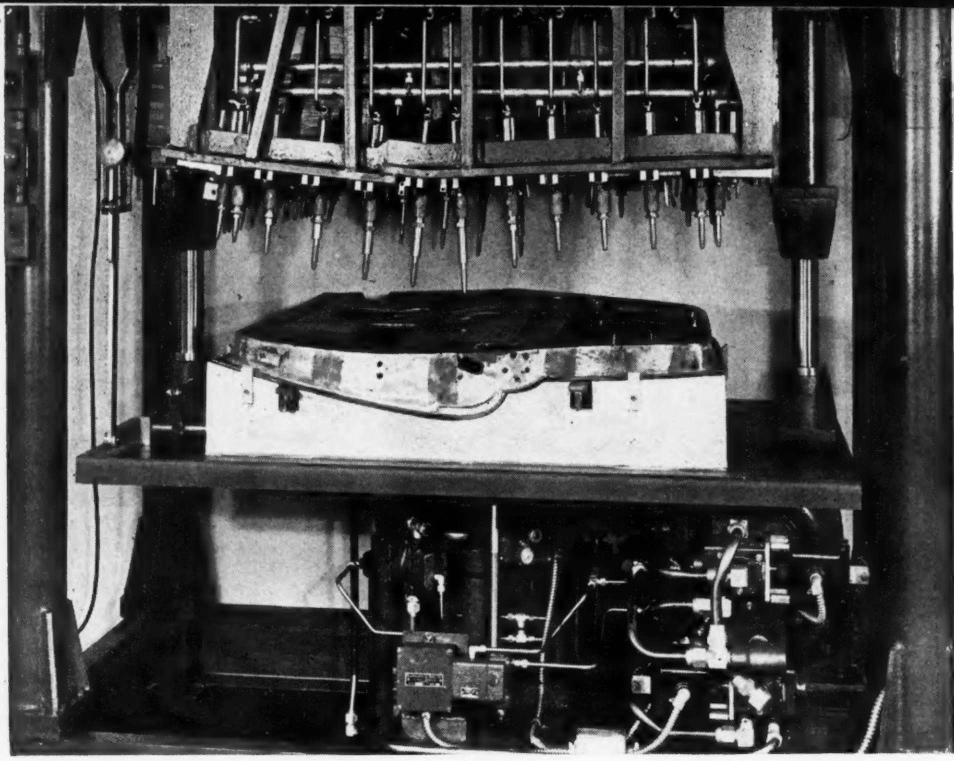


Fig. 5. Automobile Doors are Assembled on This Automatic Welding Press at the Rate of 400 per Hour by Making Sixty Simultaneous Spot-welds

current to each gun. Transformer primaries can be parallel, and all welding guns fired simultaneously or in groups. Frequently, the transformers can be fired in three groups, with each group fired across the separate legs of the three-phase supply system, thus nearly balancing the line load and improving the power factor.

The Martin automatic press shown is employed for the spot-weld assembling of a complete door. Making sixty simultaneous spot-welds, a production of 400 doors per hour is attained, compared with the 50 per hour previously produced with hand-operated welding guns.

The lower die on this press embodies the fixture and copper back-up plates for the door, while the upper die holds the electrodes, welding transformers, and hydraulic manifold for electrode actuation. Mounted in the base of the press is the hydraulic unit employed in actuating the lower table and supplying oil under pressure to the manifold of the upper die. The automatic sequencing timer is mounted on the upper structure of the press.

Right and left rear quarter-panels are gas-welded to the top of the automobile body in the "balloon" fixture shown in Fig. 6. Hand-operated torches with oxy-acetylene flames are used to make a 44-inch weld on each side of the body. The body parts are located by stops, and held by pneumatic cylinders and quick-acting clamps. Two swinging arms that pivot about horizontal shafts on the

Fig. 6. "Balloon" Fixture Used in Hand Gas-welding the Right and Left Rear Quarter-panels to the Top of the Automobile Body

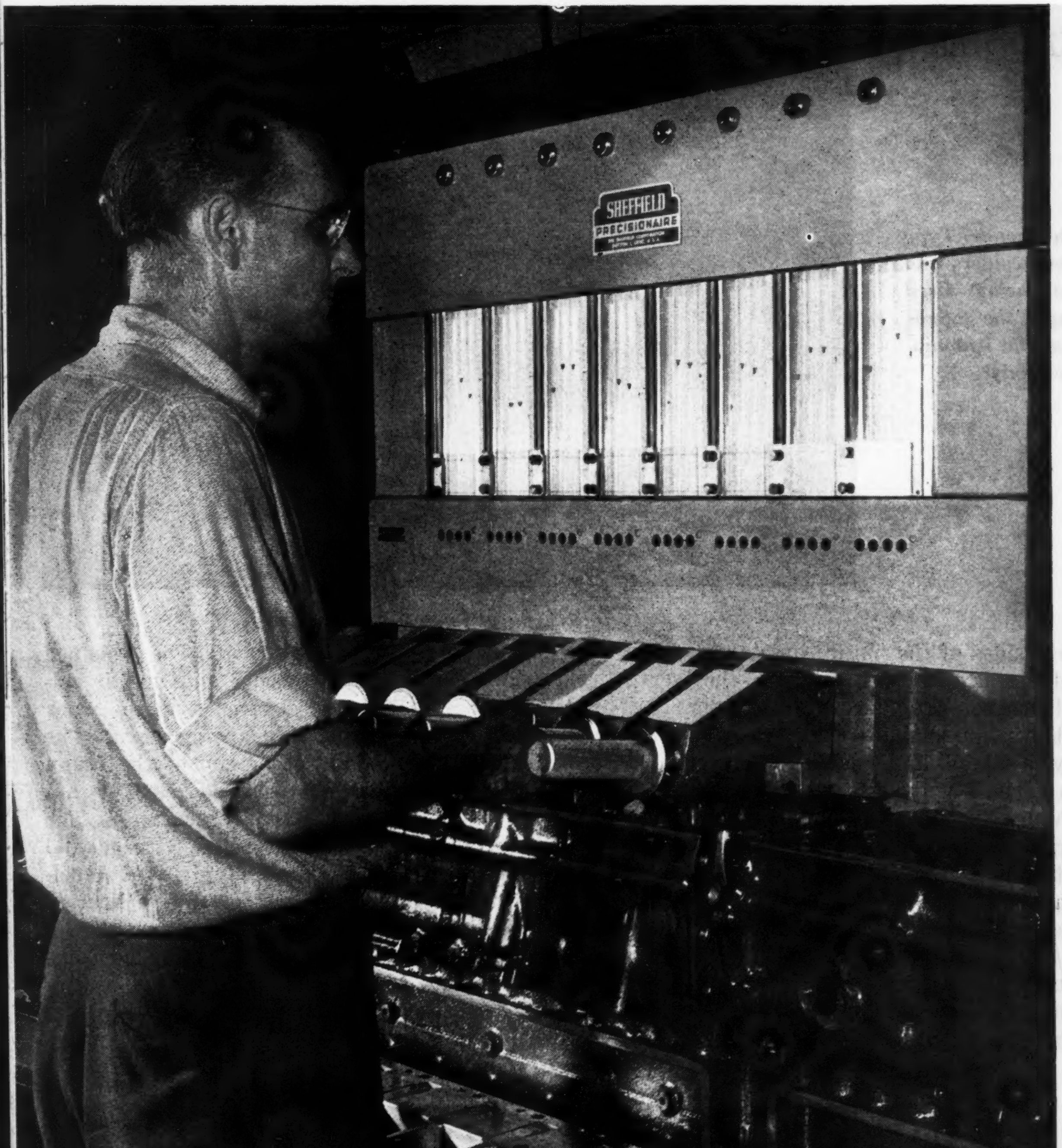
Fig. 7. Overhead Type Portable Spot-welders and Arc-welders being Used for Joining the Sub-assemblies of the Automobile Body

right and left sides of the fixture base act as weld locators and also as clamps. In addition, they serve as coolers, being cored for circulating water.

The welded sub-assemblies converge at the so-called "body in white" line, where they are welded together to form a complete unpainted body, as shown in the heading illustration. Torch welding, arc-welding, and spot-welding are all employed on this production line. The welders shown at the left and right in Fig. 7 are using portable spot-welding guns, while the other two operators—one in the foreground and the other inside the body—are performing arc-welding operations.

The portable spot-welders are supported on balancing beams suspended from small carriages that are pulled along an overhead track. The C-shaped yoke which carries the electrodes and the air cylinder for compressing the electrodes on the work is hung from one end of the balancing beam. The transformer, hung at the other end of the beam, acts as a counterbalance. Electronic controls are mounted on a platform directly over each gun. The gun and transformer are connected with coaxial conductors, which carry the welding current, cooling water, and compressed air for the application of the welding force. Quick-acting clamps and locating fixtures suspended from the overhead rails, as shown in Fig. 8, are used to hold the sub-assemblies in accurate alignment while they are being welded together.

Fig. 8. Sub-assemblies are Rigidly Held in Accurate Alignment during Welding by Quick-acting Clamps and Fixtures Suspended on Overhead Rails



Unique Inspection Machines that Gage Cylinder Bores Simultaneously at Thirty-Two Points and Classify Them for Selective Assembly with Matched Pistons are Used in the Buick Production Line. The Boring, Honing, and Finishing Operations Performed on These Close-Tolerance Bores are Described in This Article

Buick's Advanced Practice in Inspecting Cylinders

THE high quality of product specified and the production required by the Buick Motor Division of the General Motors Corporation, Flint, Mich., could not be obtained without the modern machinery and advanced practices that are much in evidence at that plant. This is especially true of the crankcase department, where a great deal of new machinery has been installed in reconverting from war production. The advanced practices adopted for inspecting, machining, and finishing cylinder bores in this plant will be described in the following.

Finished cylinder bores are held to a total taper of 0.001 inch in 9 3/16 inches, must not be out of round more than 0.00075 inch, and must be within plus or minus 0.001 inch of the 3.0925-inch mean bore diameter. To conform to such close tolerances, it is necessary to employ precise machining methods and maintain rigid inspection.

A unique feature of the cylinder inspection set-up is the use of multiple-spindle Sheffield Precisionaire machines that simultaneously gage the eight bores of each engine block at thirty-two different points and classify each bore for selective assembly with matching piston sets. The diameter, out-of-roundness, taper, and bell-mouth of all bores are checked at one time on the same machine.

Compared with former inspection systems, this new method represents a gain in efficiency and production time of more than 100 per cent. It is now possible to inspect and classify the eight cylinder bores of an engine block in thirty seconds. However, in actual practice, the average production is sixty engine blocks per hour. A large saving in floor space required for inspection has also been achieved. Each of the two inspection machines now being used in this department is approximately 4 feet wide by 8 feet long by 7 feet high.

Inspection is accomplished by the velocity or flow of compressed air. Two 5-H.P. motor-driven compressors supply the air to the machines. Either compressor is of sufficient capacity to operate both machines. The air passes through two automatic compensating pressure regulators and a water trap before entering the machines. The regulators progressively reduce the air pressure to 20 pounds per square inch, and the water trap removes any moisture which might damage the machines.

The air then enters thirty-two vertical, transparent, indicator tubes on each machine, as shown at the top of the heading illustration. These tubes are located at eye level, and are grouped into eight sets of four each. Each set of four tubes is used to gage a separate bore. The air, after passing through the tubes, is carried to eight assemblies, which each hold four spindles that closely approximate the diameter of the cylinder bore. Each of these assemblies, with their respective spindles, enters one of the cylinder bores during inspection.

The air from one tube in each set is guided to one of the four spindles in each assembly and is ejected from two diametrically opposite orifices in that spindle. Each of the sixty-four orifices is 0.055 inch in diameter. The spindles and their respective orifices may be seen in Fig. 1, which shows the spindle assemblies in their extended or inspection position. The pressure of the air emitted from one orifice balances that from the opposite orifice, thus centering the spindle within the bore.

Each of the four spindles in an assembly float independently, allowing for tolerances in the bore spacing of the engine blocks. The spindles are free to move 1/32 inch in any direction. Of course, the tolerances for bore spacing are not as great as this, but the floating feature eliminates bore location problems from this inspection.

The four spindles are located, from bottom to top of each spindle assembly, so that they align, respectively, with the extreme lower diameter of the bore and the bore positions corresponding to the lower, central, and upper travel limits of the piston. These four positions are indicated on the four tubes in each set. The right-hand tube shows the diameter of the bore at the upper limit of the piston travel; the second tube, the diameter at the center of the piston travel; the third tube, the diameter at the lower limit of the piston travel; and the left-hand tube, the diameter at the top of the bore.

The volume and velocity of air flowing at any given instant during the gaging operation depends

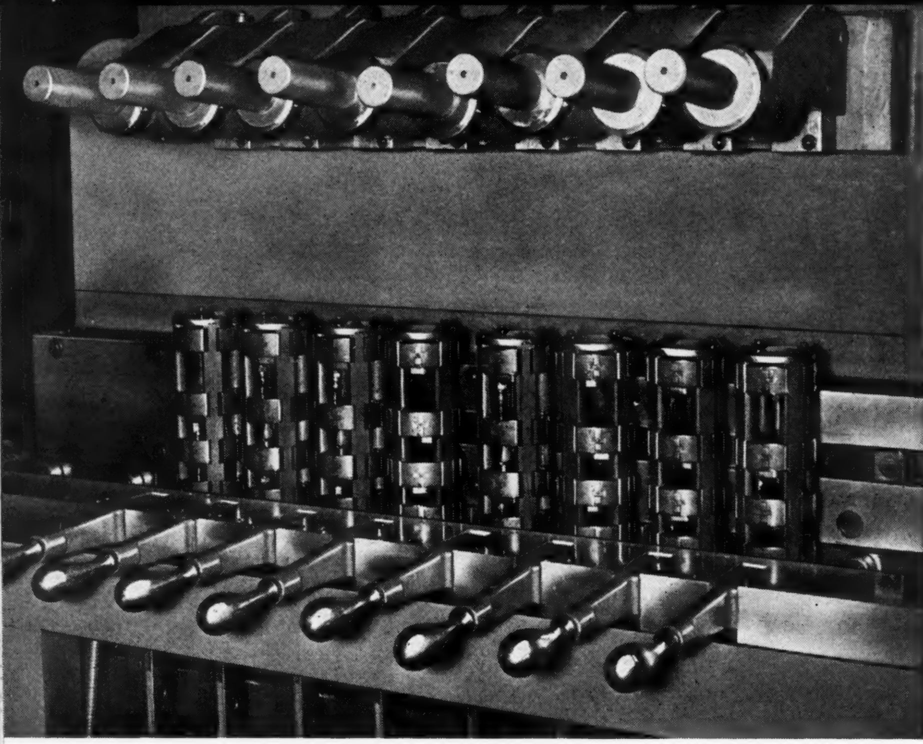


Fig. 1. The Eight Spindle Assemblies, which Each Contain Four Spindles and Eight Air Orifices, are Shown in the Extended or Inspection Position. The Eight Handles at the Lower Front are Used to Turn the Spindle Assemblies through 180 Degrees for Out-of-roundness Inspection

upon the clearance between the gaging spindle and the surface of the bore being inspected. The greater this clearance, the higher the velocity of air that passes between the periphery of the spindle and the bore. The spindles are made 0.001 inch smaller in diameter than the minimum cylinder bore diameter.

Aluminum indicator floats or "bobbers" are located in each of the thirty-two transparent tubes. These bobbers are free to move up and down in the tubes in response to any change in velocity of the air passing through the tubes and around the float. The greater this velocity, the higher the float rises in the tubing. For example, a cylinder bore diameter 0.0001 inch larger than minimum will permit more air to flow between it and the gaging spindle, thus increasing the velocity of the air and causing the float to rise 1/8 inch in its tube.

The inspection machines are an integral part of the cylinder-block production lines. After the bores have been honed, the blocks are pushed along roller conveyors to the loading station on the right-hand side of the inspection machine. The bores are inspected in a position opposite to that in which they are machined, honed, and operated, so that the crankcase section of the block is near the top and the upper portion of the bore is near the base of the inspection machine.

With an engine block in the loading position, the starting button of the machine is depressed. This actuates two hydraulically operated loading arms, one at each end of the block, which advance the block along roller bearings to the inspection position shown in the heading illustration. Here, two hydraulically actuated plungers automatically enter

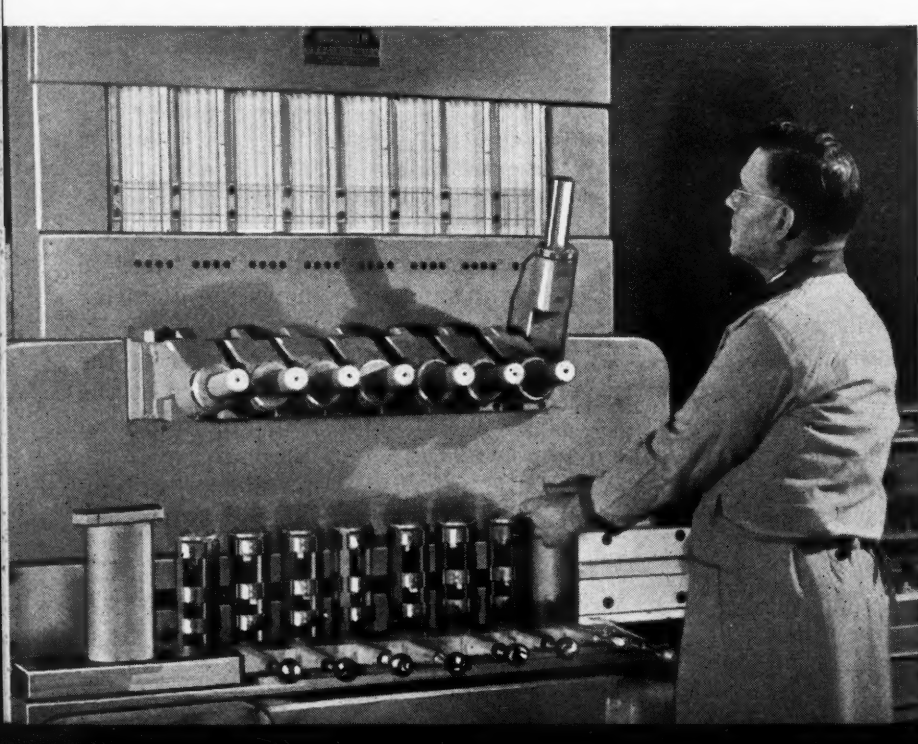


Fig. 2. Here the Inspector is Calibrating the Set of Tubes Used in Gaging the Right-hand Cylinder Bore. A Minimum Bore-size Master Ring Gage is Employed

locating holes in the back face of the engine block, thus forcing a machined surface on the front of the block against a ground face on the inspection machine. A pin simultaneously enters a hole in the top surface of the block, thus accurately and rigidly locating and clamping the work.

With the block thus properly aligned, the eight spindle assemblies are automatically elevated by means of hydraulic cylinders in the base of the machine and entered into the respective bores of the block. The machine stops automatically in case interference, such as binding or seizure from metal chips or an undersized bore, is encountered by any one of the spindle assemblies. In that event, one or more of the red lights at the top front of the machine will be illuminated, thus showing in which bore or bores the interference is occurring. After entering the bores the required distance, the spindle assemblies automatically stop and inspection is begun.

The float in the left-hand tube, which indicates the diameter at the top of the cylinder bore, should always be lower than or even with the floats in the other three tubes. This shows that the bore taper is in the correct direction to permit assembly of the piston. Such a condition is called an "open bore" or bell-mouth. If the float in the left-hand tube is higher than any of the others, it shows that an incorrect taper exists and, consequently, further machining is required.

At the right of each set of four tubes on the inspection machine are graduations numbered from 1 to 10, inclusive. The difference between any two successive graduations corresponds to a 0.0003-inch difference in the diameter of the cylinder bore. When the air is turned on, to gage an engine block, the floats in all thirty-two tubes instantly fall to positions opposite or near a number on the graduated scales. The bore diameters are held within a limit of 0.002 inch. This limit corresponds to the distance between the heavy lines at the "1" mark and two-thirds the distance between the "7" and "8" marks on the graduated scales. The highest and lowest floats in each set of tubes must not be beyond the limits set by these heavy-line graduations.

A transparent tolerance slide, 0.001 inch high, stretches across each set of four tubes. These slides are adjustable vertically on friction ways located to the left of each set of tubes. Two horizontal lines, spaced 0.00075 inch apart, are engraved on each slide. These slides are so positioned as to determine if all four floats in each set are within the taper and out-of-round limits.

The total taper of each bore is held to 0.001 inch. This distance is represented by the height of the transparent slide. All four of the floats must be within this distance to insure that the difference in bore diameters does not vary more than 0.001 inch from top to bottom of the cylinder.

The out-of-round limit of 0.00075 inch is checked by reference to all four tubes. Thus, the bore is held to this limit outside of the piston travel, as well as within the piston travel. In order for a cylinder block to pass the out-of-round inspection, the floats in these tubes must be within the two horizontal scribed lines on the slide. The spindle assemblies can be manually rotated through 180 degrees for this inspection by means of the eight

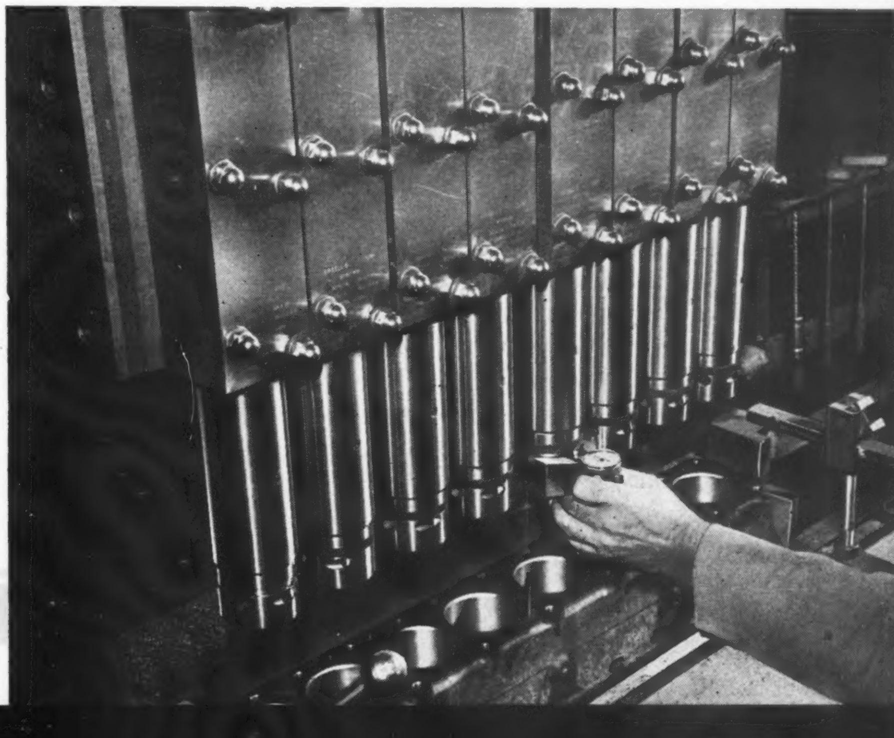


Fig. 3. A Dial Indicator Type of Gage is Used to Set the Carbide-tipped, Single-point Boring Tools Used for the Precision Boring Operation on the Machine Shown in Fig. 4

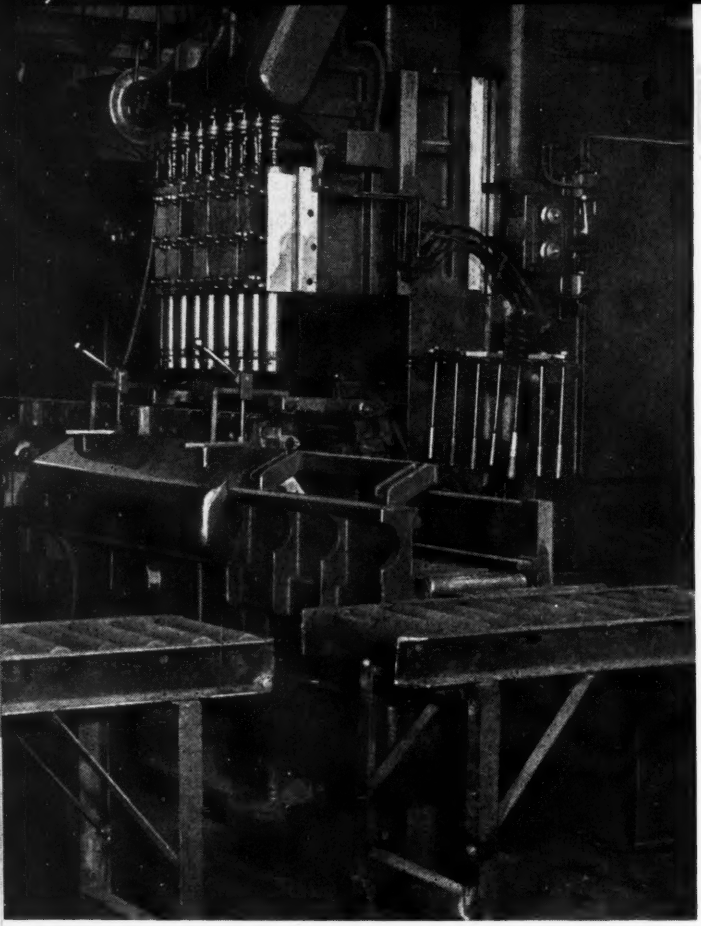


Fig. 4. Special Eight-spindle Ex-Cell-O Hydraulically Operated Machines are Used for the Precision Boring of Buick Engine Blocks. Spindles are Revolved at 500 R.P.M. and Fed at 0.007 Inch per Revolution

hand-levers shown at the base of the inspection machine, flush with the bottom of the cylinder block. A full 360-degree rotation is not required because of the two opposing orifices on each spindle.

Bores are Classified and Stamped for Selective Assembly with Matching Piston Sets

The position of the float in the right-hand tube of each set, which indicates the diameter of the bore at a position corresponding to the upper limit of the piston travel, is called the "sizing point." The size, which must be determined for the fitting of matching pistons, is taken to the nearest 0.0003 inch, and is indicated by the number opposite the float in this right-hand tube.

This number is stamped manually on the engine block directly beside the cylinder bore so classified. The stamping is accomplished by individual marking devices mounted directly above each of the spindle assemblies. An inspector is shown in the heading illustration stamping the seventh cylinder bore with a No. 7 classification. The marking devices are hinged on the front of the inspection machine, and their marking rings, which bear the numbers from 1 to 10, inclusive, are easily revolved to the desired marking by turning the knurled handle. The inspector punches on a mechanical counter the quantity of bores bearing each classification mark. The totals registered on the counter at the end of each day are transmitted to the piston department for necessary matching production.

After all eight of the cylinder bores have been stamped, the spindle assemblies and locating pins are withdrawn and the cylinder block is moved along the conveyor. The machine is then ready for another inspection cycle on the next engine block.

These inspection machines are calibrated by means of master ring gages. An inspector is shown in Fig. 2 setting the minimum tolerance limits of the right-hand set of tubes by means of a minimum master ring gage mounted on the right-hand spindle assembly. While mounted in the gaging position on the inspection machine, the cylinder bores can be measured accurately to within 0.0001 inch by interpolating between the graduations. However, as this accuracy is not required, the scale is only graduated at 0.0003 inch intervals. The bottom of each tube is provided with a bleeder valve for setting the initial position of the float in the tube. This is necessary to compensate for the taper of the tubes.

The Boring and Honing Operations that Precede the Final Inspection

Accurate machining is necessary to maintain the close tolerances specified for final inspection of the cylinder bores. The bores are rough-, semi-finish-, and precision-bored and honed before inspection.

The cylinders of the cast-iron engine blocks are first rough-bored on an Ingersoll eight-spindle, vertical boring machine. A cutter-head with six solid-cobalt, single-point boring tools set at intervals of 60 degrees around its periphery is mounted on each spindle. The relatively heavy cut taken in this operation, which increases the rough-cored bore diameter in the engine blocks by as much as 3/8 inch, is distributed among these six cutting tools. The spindles are driven at a speed of 125 R.P.M. and fed at 0.075 inch per revolution.

Semi-finish-boring of the cylinders is accom-

plished on a similar machine. Cutter-heads having two carbide-tipped, single-point boring tools set 180 degrees from each other are mounted on the spindles of this machine. This operation removes 0.035 inch from the bore diameter with a spindle speed of 300 R.P.M. and a feed of 0.025 inch per revolution.

The cylinders of the engine block are then precision-bored on Ex-Cell-O eight-spindle, automatic, vertical boring machines, one of which is shown in Figs. 3 and 4. These machines are installed on individual concrete foundations, 9 feet deep, to minimize the transmission of vibration from surrounding equipment. One brazed, carbide-tipped, single-point cutting tool is mounted in each spindle. A dial indicator gage, as shown in Fig. 3, is used for setting the cutting tools to remove 0.012 inch from the bore diameter. The tools are jig-ground from 3/8-inch diameter round bits with brazed carbide tips. They are provided with an end cutting-edge angle of 30 degrees, a side cutting-edge angle of 25 degrees, a nose radius of 0.015 inch, an end relief angle of 25 degrees, and an end clearance angle of 30 degrees. There is no side or back rake.

These special boring machines are completely automatic. When the starting button is depressed, locating pins automatically enter holes in the engine casting and hydraulic clamps simultaneously move into position at both ends of the block to restrain it from moving during the boring operation. The eight-spindle head, with each spindle gear-driven at 500 R.P.M., is rapidly traversed hydraulically to the boring position, where a boring feed of 0.007 inch per revolution begins. A gear-box at the top of the machine contains a cone-worm drive for each spindle, which insures a smooth drive and also stops the spindles with all the tools in the same position circumferentially. All the worms in the gear-box are driven from one shaft. The hydraulic pressure is supplied by an independent motor, pump, and sump unit.

At the completion of the boring operation, the spindles automatically stop, the block-holding fixture tips 0.012 inch, and the spindle head is rapidly retracted to the starting position. The tipping feature of the fixture prevents the tools from scoring the bores while they are being withdrawn. Previously, in using fixtures without this feature a tool mark as deep as 0.003 inch was produced in the cylinder bore when the tool was retracted, necessitating much more frequent tool grinding.

While tolerance of 0.001 inch is specified for this operation, it has been found in the subsequent inspection operation, that the bores are consistently within 0.0003 to 0.0006 inch of the desired size.

The cylinder bores are next honed on Barnes eight-spindle, vertical, hydraulic honing machines, such as the one shown in Fig. 5. Honing sticks of 150 grit, J bond, assembled with a spring pressure of 90 pounds, are used. Such sticks have a honing life of approximately fifty engine blocks. About 0.001 inch is removed from the bore diameter. Metal particles are eliminated from the lubricant used for this operation by means of magnetic coolant separators.

Cylinder Bores are Chemically Treated to Provide Them with an Oil-Absorbent Coating

Following the honing operation, the cylinder bores are treated by a Lubrizing process, which is patented by the Parker Rust-Proof Co. This process consists of a chemical treatment that produces

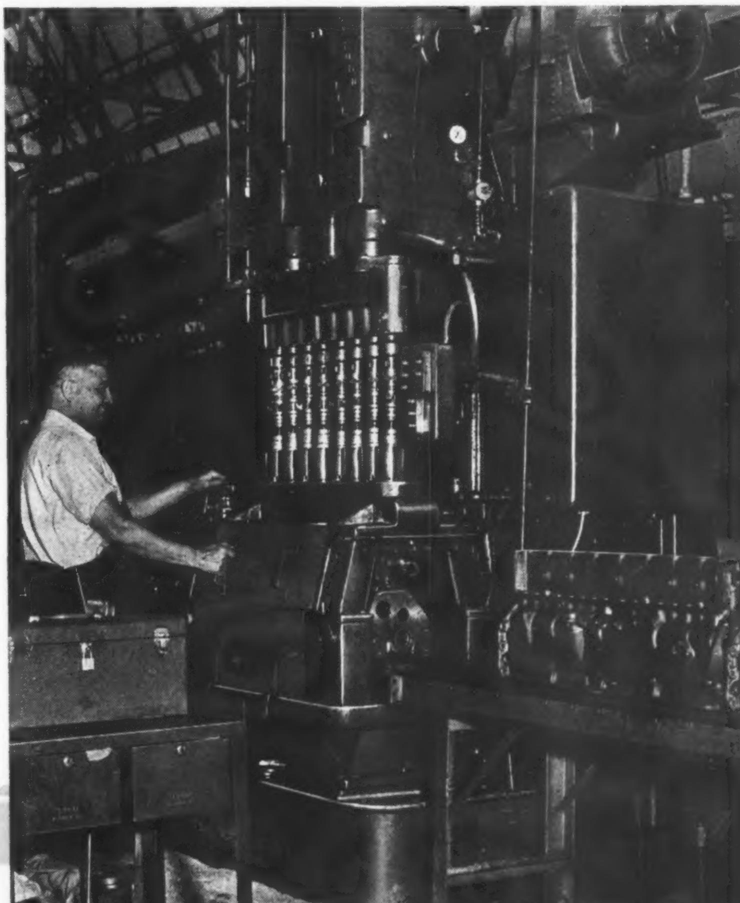


Fig. 5. The Cylinder Bores of Engine Blocks are Honed on Barnes Eight-spindle Vertical Machines. About 0.001 Inch of Material is Honed from the Bore Diameter

Fig. 6. *One of the Twenty-two Fixtures of the Lubrizing Machine which Each Hold a Cylinder Block while the Solution is Pumped through the Bores*

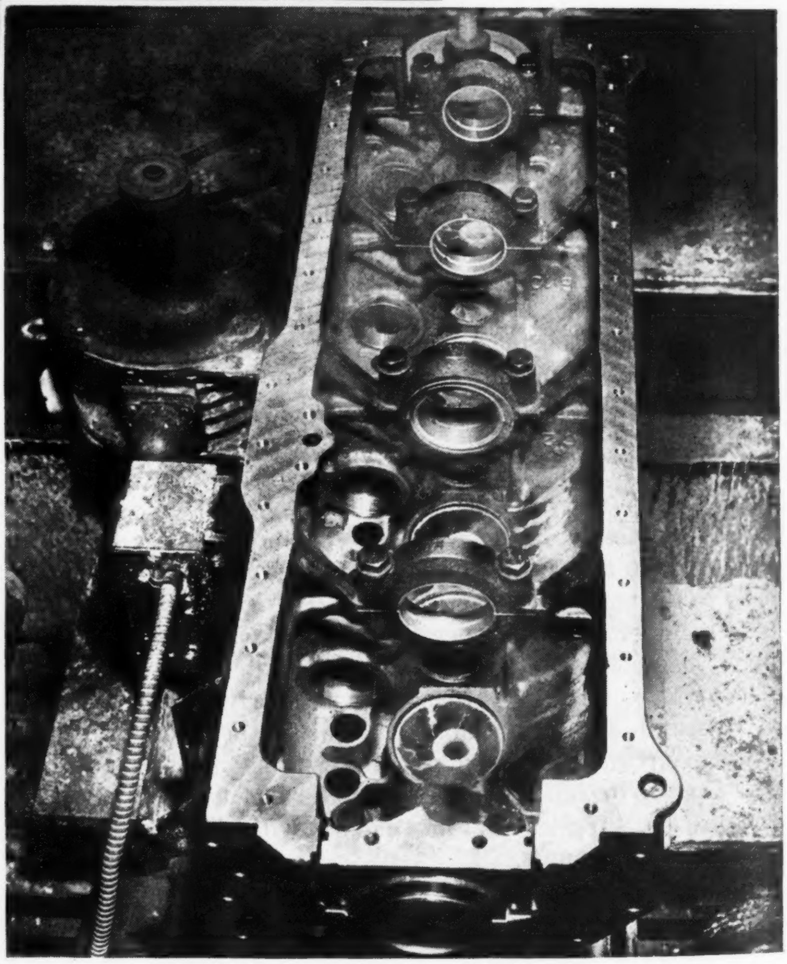


Fig. 7. *Lubrizing Solution is Pumped through the Cylinder Bores of the Engine Block to Impart a Non-metallic Oil-absorbent Coating on Their Surfaces. The Pipes Shown in the Center of Each Cylinder Handle Overflow of the Solution, thus Preventing it from Coming in Contact with Surfaces Other than the Cylinder Bores*

a non-metallic, oil-absorbent coating on the wearing surface of the cylinder bore. The affinity of this coating for oil minimizes the danger of metal-to-metal contact between the piston and the cylinder bore. This type of lubrication permits the rapid breaking-in of moving parts without scoring or scuffing, and reduces subsequent wear.

The coating imparted by this process consists principally of iron and manganese phosphate, which results from a chemical reaction between the solution and the metal surface. Electric current is not used. This chemical combination with the base metal gives the coating great adherence. Any metal burrs remaining from the boring or honing opera-

tions are rapidly dissolved and removed by this process.

The first step in the Lubrizing process is the cleaning of the engine blocks. This is accomplished by passing them through a washer which sprays them with an emulsion cleaner, heated to approximately 170 degrees F. A rinse and air-blast drying complete this stage of the process.

The engine blocks are then placed on the Lubrizing machine, which consists of a circular conveyor carrying twenty-two work-holding fixtures, such as the one shown in Fig. 6. The fixtures form water-tight joints with the blocks. Each fixture holds one engine block, and is equipped with a motor-driven pump.

The pumps transfer the Lubrizing solution, which is made from a mixture of 10 per cent Parco Lubrite and water heated to approximately 210 degrees F., from a central storage tank to the eight cylinder bores in each block. One of these pumps may be seen to the left in Fig. 7. The solution is pumped through the cylinder bores at the rate of 7 gallons per minute. The fixtures contain 1-inch diameter overflow pipes which extend up through the center of each bore, terminating at a point flush with the ends of the cylinders. This prevents the solution from coming in contact with surfaces other than the cylinder bores. The time required for this process is fifteen minutes per cylinder block. The engine blocks are removed from the Lubrizing machine at the end of the conveyor, and the cylinder bores are rinsed for one minute with water at a temperature of approximately 150 degrees F. The bores are then coated with a solution containing one part of soluble oil in twenty parts of water, which is also kept at a temperature of approximately 150 degrees F.

The black, fine, non-metallic, crystalline coating formed by the Lubrizing process reduces the bore diameters by approximately 0.0005 inch. This amount of the coating is removed by lapping on a Barnes, eight-spindle, vertical machine. Cast-iron stick lapping heads, of the same diameter as the piston assembly to be used in the completed engine, are reciprocated through the bores seven times. The engine blocks are again cleaned and dried by passing them through another washing and drying machine before they leave the crankcase department.

Western Metal Congress and Exposition

PRELIMINARY plans for the resumption of the Western Metal Congress and Exposition have been completed, and the event will be held in the San Francisco-Oakland Golden Gate area for six days beginning March 22. The last Exposition was held in Los Angeles in 1941, war restrictions having prevented it from taking place in the intervening years. The Congress and Exposition will again be sponsored by the American Society for Metals, and will have the active cooperation of West Coast chapters of the leading technical societies. The technical program will include papers and round-table conferences of interest to the metals, aviation, petroleum, chemical, mining, and general manufacturing industries.

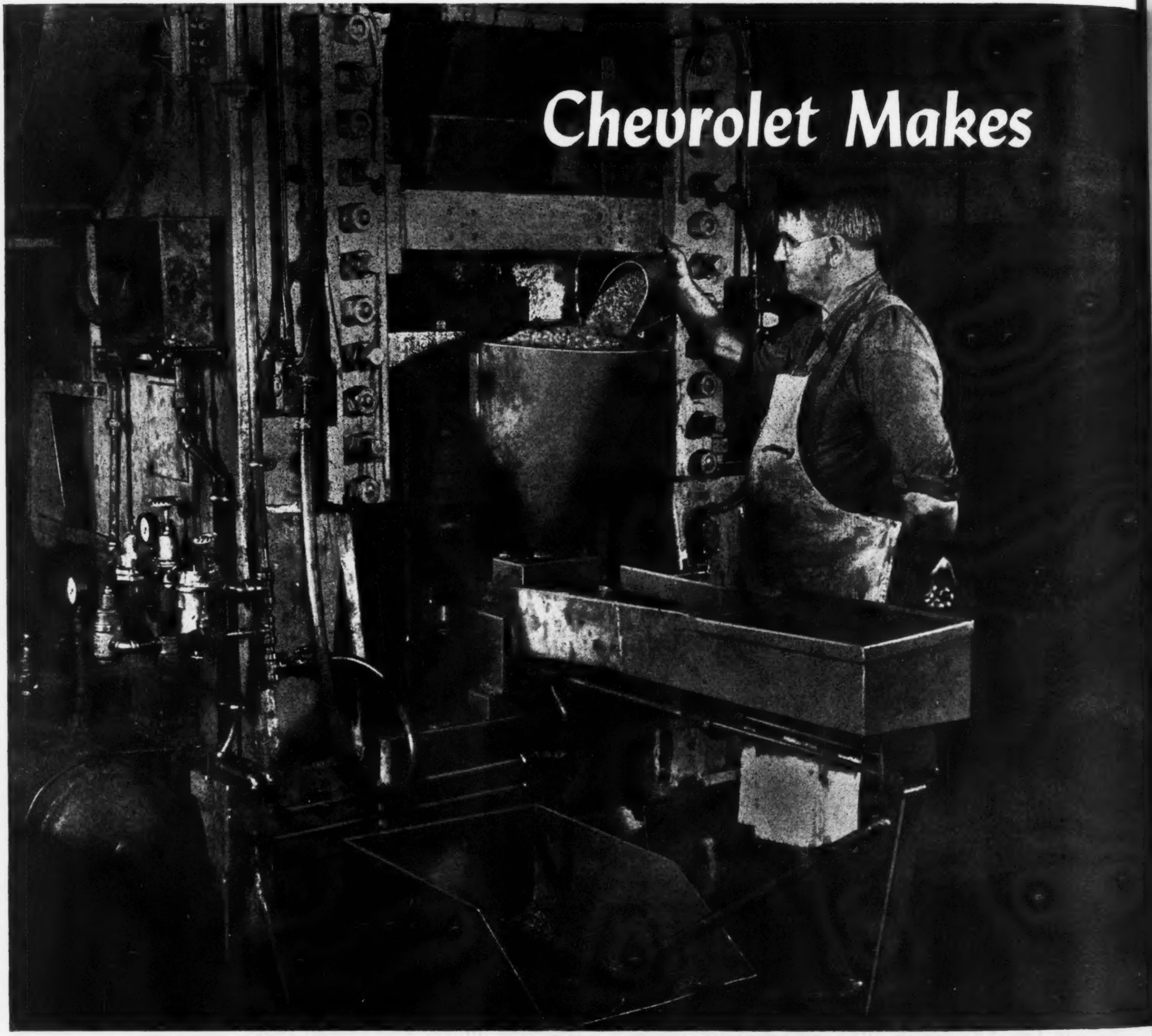
In the Exposition will be shown equipment and methods relating to the metals industries, including raw materials; heat-treating apparatus and supplies; inspection methods and equipment; machinery; foundry supplies; materials-handling, welding and cutting, oil-field equipment; small tools; and finished products. The technical sessions of the Congress and exhibits will be held in the two large civic auditoriums at Oakland. Attendance at the 1941 Western Metal Congress and Exposition was approximately 50,000, and it is expected that the 1947 figures will exceed that.

Further information can be obtained from W. H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

* * *

A.S.T.E. Convention Cancelled

The semi-annual convention of the American Society of Tool Engineers, which was scheduled to be held in Pittsburgh October 10 to 12, inclusive, had to be cancelled because of the power union strike that is paralyzing most of the industry of Pittsburgh. The next scheduled national meeting of the Society will be the annual convention, which is to be held at Houston, Tex., in March, 1947.



A UNIQUE process by means of which steel chips are formed directly into bearing lock sleeves has been developed by the Chevrolet Gear and Axle Division of the General Motors Corporation. Ordinarily, of course, such chips must be sent to the steel mill and remelted into ingots before they can be converted into production parts. Prior to the adoption of this process, the bearing lock sleeves were machined from cast iron. Now machining has been completely eliminated, and a superior sleeve is produced at the rate of 455 per hour and a saving of 40 per cent.

Dimensions of the finished part are shown in Fig. 2. Such sleeves have a hardness of Rockwell 78 to 90 B, and will withstand a minimum load of 2500 pounds before fracturing when one half of the sleeve is clamped rigidly, and the other half is loaded with a 3/4-inch diameter punch.

The chips used in this process, shown at *A* in Fig. 1, are S A E 1112 steel formed from torque-tube bushing operations on automatic screw machines. These chips are carefully segregated from other turnings to prevent contamination. They are placed in the perforated basket of a centrifugal chip wringer and rotated for forty-five minutes to remove the oil from their surfaces. The dry chips then go to a shredding machine, where their size is reduced. Following the shredding operation, the

Parts Directly from Steel Chips

chips are screened, and those passing through the screen, as shown at *B*, are used for forming the briquette.

The cold-forming of the briquette *C* is accomplished by means of a die mounted on a Cleveland coin press rated at 600 tons and having a stroke of 10 inches. The chips are fed to the machine by a hopper, as shown in the heading illustration. They fall into holes in a reciprocating slide that is actuated by a 3-inch diameter by 18 1/2-inch stroke air cylinder. As the horizontal slide advances, it seals off the hopper, preventing additional flow of chips. A smooth steel die surface over which the slide passes prevents the chips from falling out of the holes until they are in the proper position over the die opening.

After dropping the required amount of chips into the die, the slide is returned to its original position by the air cylinder to obtain another load of chips, and the punch descends, exerting a pressure of approximately 400 tons to squeeze the chips into the briquette. This cold die forms the inside diameter of the part to its finished taper size. The outside diameter, however, is cold-formed to 3.156 inches.

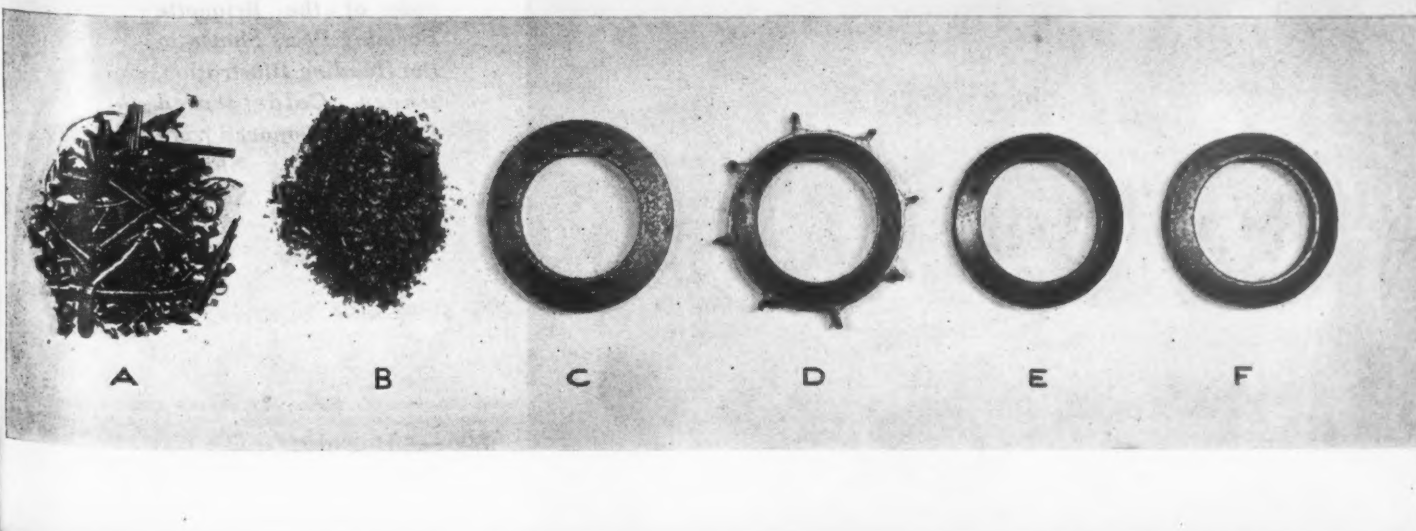
The briquette is ejected from the punch onto a swinging, unloading shovel on the opposite side of the press, as shown in Fig. 3. At this stage, the parts are quite brittle and it is necessary to remove the parts from the shovel manually and stack them. Periodically, a part is weighed, as shown, to see that it conforms with the specifications of 9 ounces, plus 1/2 ounce minus 0. When parts vary from this weight, finer or coarser chips are added to the mixture in the feeding hopper.

The briquettes are now heated to 1850 degrees F. in a controlled-atmosphere electric furnace, as shown in Fig. 4. They are placed on heat-resistant alloy steel carriers, which are pushed through the furnace in six rows by levers actuated by a gear-driven camshaft. The controlled atmosphere, which is manufactured in a generator adjacent to the furnace, prevents the formation of scale which would interfere with subsequent forming operations. This treatment does not harden or otherwise change the physical properties of the metal, but simply heats it to facilitate forming. Each part is subjected to the heat for fifteen minutes.

Upon the completion of the heating period, the red-hot briquettes are transferred by means of tongs from the unloading end of the furnace to a die mounted in a Cleveland geared, eccentric, mechanical press rated at 900 tons, as shown in Fig. 5. The carriers on which the parts are transported through the furnace are placed on an endless belt conveyor at the side of the furnace and returned to the loading end.

The punch used for the following operation is of the hollow water-cooled type, and is screwed to the upper part of the die. It has a tapered nose, so that when it descends with the ram of the press it will center the hot briquette in the die. The shape of the punch conforms with the inside taper of the hot part, so that there is no change in these fin-

Fig. 1. Successive Steps in the Production of Bearing Lock Sleeves, from the Steel Chips Seen at A to the Finished Part Shown at F



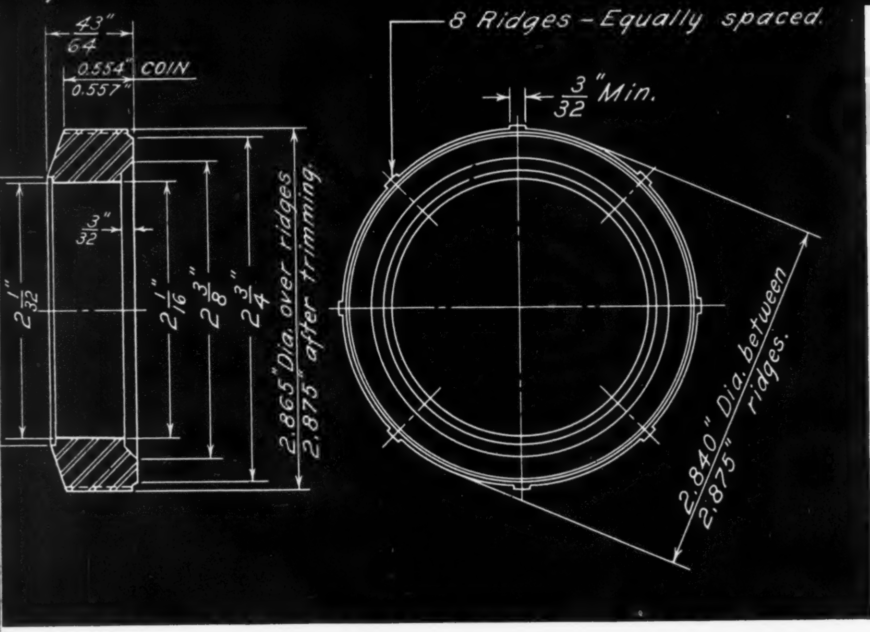


Fig. 2. Detailed Dimensions of the Bearing Lock Sleeve which is Formed Directly from Steel Chips

ished dimensions. The outside diameter of the briquette, however, is reduced from 3.156 inches to between 2.840 and 2.875 inches, and eight equally spaced ridges, 3/32 inch thick, are formed on this surface.

This reduction in the outside diameter of the hot briquette, with the inside diameter and height remaining the same, compresses the granulated steel chips into a dense structure having the required physical properties. The great pressure necessary for this operation is secured by eight radially located toggle punches, which are pivoted on pins mounted on sliding plates. These toggle punches are forced to the center by ball-and-socket joints in the reciprocating vertical bars of the die. Some of the metal in the briquette is forced out into the spaces between the eight toggle punches, thus forming the ridges on the outside diameter of the part, as shown at *D* in Fig. 1.

The hot-formed part thus produced is now placed in a trimming die on a Toledo 106-ton mechanical press, which shears the ridges on the outer periphery of the part to the desired height, resulting in an over-all diameter of from 2.865 to 2.875 inches. The thickness of the part at its outer periphery is then accurately finished to from 0.554 to 0.557 inch by a cold-coining die mounted in a Toledo 400-ton press.

Finally, the coined bearing lock sleeves are tumbled in barrels containing sawdust to remove burrs, scale, and loose particles; passed through an alkali washer to remove oil from their surfaces; and inspected. Sleeves that pass the final inspection are placed on pinion-shafts in sub-assembly, as shown in Fig. 6. When the sub-assembly is placed in the final drive housing, three set-screws are used to lock the sleeve in place, thus preventing end play of the hypoid pinion gear thrust bearing.

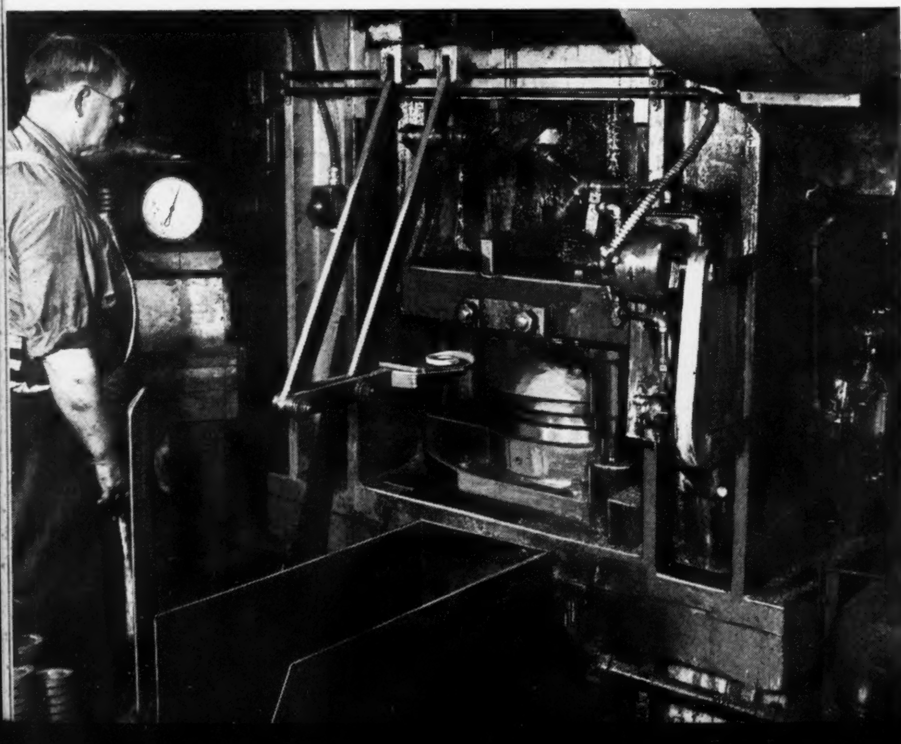


Fig. 3. The Unloading Side of the Briquette Forming Press Shown in the Heading Illustration, where Cold-formed Parts are Removed from the Swinging Shovel, Weighed, and Stacked

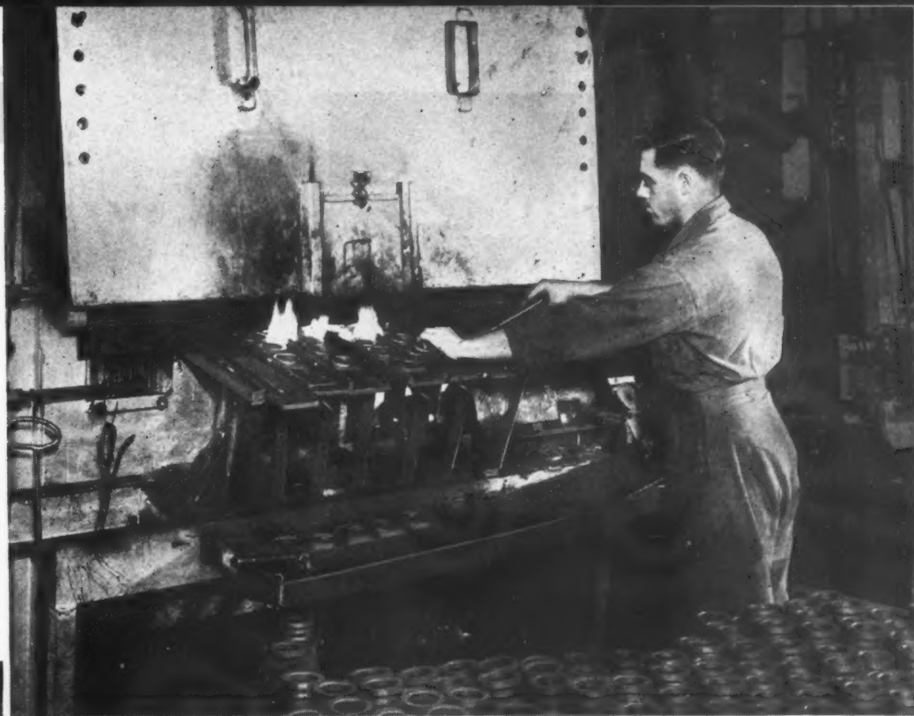
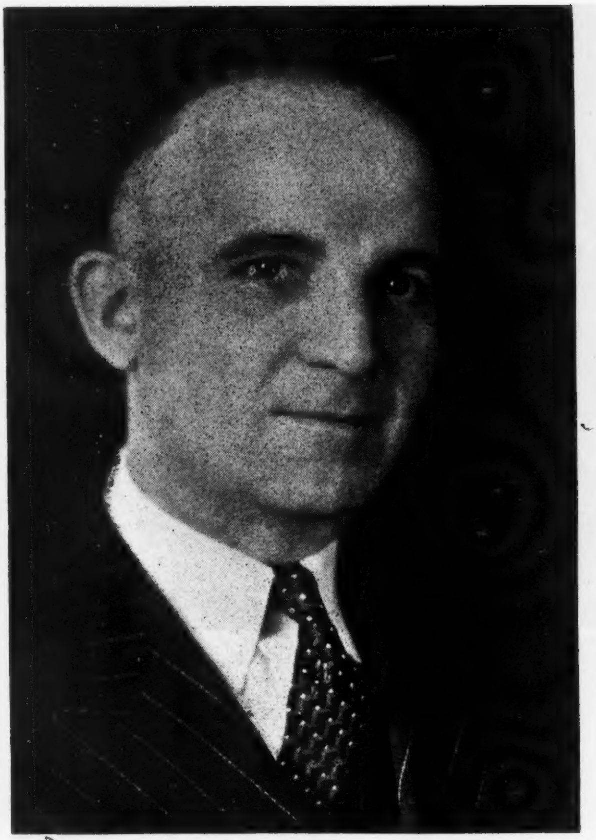


Fig. 4. (Right) Briquettes are Loaded into One of Six Rows in a Continuous, Controlled-atmosphere Electric Furnace where they are Heated to 1850 Degrees F. prior to Forming into Finished Shape

Fig. 5. (Left) Unloading End of Furnace Shown in Fig. 4, where the Hot Briquettes are Placed in a Die on the Press Illustrated and Formed to the Shape Shown at D in Fig. 1

Fig. 6. (Right) Finished Sleeves that have been Inspected are Placed on Pinion-shafts in Subassembly



What Production Way of New

IN the last few years before the outbreak of World War II, machine tool builders were making all-out efforts to improve the efficiency and appearance of the machines being supplied to automotive manufacturers. Modernized appearance, quietness, and efficiency of operation were three of the features sought by purchasers. A condition existed in industry that made close competition a major concern of the machine tool builders. This keen competition, which provided a stimulus to research and development, was, however, finally overshadowed by the clouds of an impending war, and this nation became involved in an all-out program of producing the greatest amount of machine tools in the least possible time.

The tried and proved "work horse" types of machines which were threatened with replacement by improved, streamline, specialized models suddenly began finding their way into new and converted manufacturing enterprises. Some of the "period type frills," as well as the highly glazed "paint jobs," were missing. The nickel- and chromium-plated nameplates and beautifying gadgets were also conspicuously absent. The "war specified paint jobs" were produced in unbelievable numbers because all the patterns and jigs were available.

Now we are reconverting all facilities into peacetime activities, and the spirit of economic and competitive production again is foremost in manufacturers' plans. So we turn again to the field of research and development to provide highly specialized, cheaper, and better methods of production.

As users of machine tools in great numbers, production executives of the Ford Motor Co. would like to see certain improvements embodied in the machine tools of the future. Among them are: (1) Leak-proof hydraulic cystems; (2) more rigid tool-spindles, adapted for the use of the improved cutting materials, such as the sintered carbides; (3) flush-mounted electrical equipment, to increase safety and improve appearance; and (4) symmetrical contours, free from protruding ribs.

Now to elaborate on these four features: First, the hydraulic systems. At present, most hydraulic equipment, carefully assembled at leisure under normal tool-room conditions, has a fairly good chance of functioning properly until wear occurs in various degrees. Wear, however, does not occur at any prescribed time, but usually is accompanied by total or partial breakdowns at the most inopportune times to the shop, when production is at peak tempo. The results are production loss, disorganization, and frayed nerves.

A hurried repair is often effected under tense conditions, and faulty operation results. It would, therefore, be a great advantage if hydraulic equipment were of simpler design and more easily assembled and disassembled. Piston-rods in hydraulic cylinders are continually becoming scored, causing leaky packing glands. Fittings that can be pulled down on one side and are permitted to remain uneven can and will produce either immediate or future leaks. Joint faces of valves and gaskets in various assemblies are often scratched. Under high pressures the scratches leak profusely. The faces of many hydraulic cylinders are sent to assembly lines with razor-sharp edges, which nick rubber rings and seals when they are assembled, to the detriment of the system's efficiency.

Regarding suggestion number 2—more rigid tool-spindles: Much research has been carried on in Government-sponsored projects, such as those on metal-cutting research at the University of Michigan and the California Institute of Technology. Findings of these projects were mailed to industry

Engineers Would Like in the Machine Tools

By WILLIAM F. PIOCH
Chief Production Engineer, Ford Motor Co.

periodically by the Office of Production Research and Development. The information was printed on loose-leaf sheets and made an excellent metal-cutting handbook.

These studies, as well as private research, have proved conclusively that the spindles of machine tools built before World War II are not made for the present-day highly developed cutters and tools. In a great number of cases, existing machines do not have spindles designed to run at the speeds required to obtain best results with modern cutters.

Another point that bears directly on this problem is that many machines are not supplied with sufficient horsepower for such operations as high-speed negative-rake milling. In some machines of vertical design that were put into wartime service, the spindles would not stand up under the extremely high speeds that were necessary for machining aluminum and magnesium. Ford engineers would like to see machines of the future provided with speeds far in excess of any built previous to World War II.

The third feature that should be incorporated more generously in new machine tools is the mounting of electrical controls that do not give the impression of being simply "hung on." So many controls of push-button and lever types are "stuck" on the machine wherever a flat face of sufficient size is available. A machine that has been designed with due care is sometimes completely spoiled in appearance by attaching electrical equipment on every available area. More care should be taken to provide proper location for this equipment.

Oftentimes a push-button is placed where unintentional body pressure can set off an operating cycle, which may be dangerous to both the operator and the machine. In one instance, an operator leaned over the edge of his machine in trying to wipe off a bit of dirt that had become lodged on a locating face. In so doing, he leaned against a depressed type of button switch, and even though the push-button was below the switch body surface, some object on the operator's person provided sufficient pressure on the push-button to make contact. Three broken fingers resulted when a hydraulic clamp suddenly went into action.

The fourth feature listed as being desirable in new machine tools is general symmetry and simplicity in appearance. Many a chuckle could be gotten out of scanning the pages of a 1905 mail order house catalogue devoted to the organs that adorned the parlors of those days, but machine designs of that same age are still common in many shops. The trend of machine design that was common many years ago is still characteristic of some recently purchased machine tools.

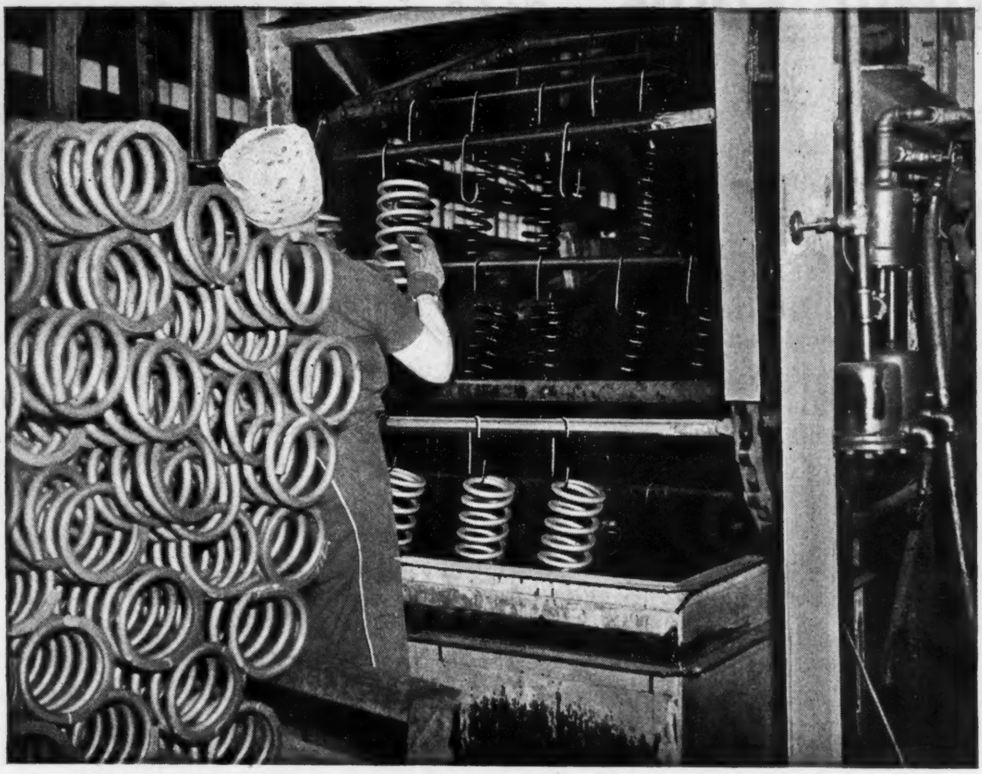
It is true that many machine tool manufacturers have made progress along the lines of appearance, but not enough of them have considered this important point. External smoothness and symmetry are necessary to complete a design of harmony and balance. Small pockets created by external ribs can have only one result, and that is untidiness. Since machines in an automotive shop are run three shifts, the feeling of "my machine" that existed when only one operator ran a machine has been lost to a considerable degree. When one operator was responsible for a machine, personal pride in the general appearance of the equipment often existed, and the operator cleaned the machine with much more thoroughness than is usually the case when such responsibility is shared by several operators. It is, therefore, more essential now than ever before to incorporate simplicity of design and easily cleaned surfaces in all machine tools.

Corners of machine housings should have large radii, coolant pans should be easily drained, chip boxes or chutes should be accessible, motors should be placed where contortionists are not required for motor repairs or changes. The adjustment of bearings and the changing of V-belts should be easy operations, and not major mechanical maneuvers.

Generally speaking, the designer should have a mental picture of what his creation will look like, and mentally proceed through each mechanical function and possible operation—both from a production and a maintenance standpoint. Motors should never be placed where the fans for self-cooling blow a continual gust of air on the operator. Motors should be put out of sight but still "out of dirt."

The chief goal in machine tool design should be simplicity of operation and general appearance.

Hot-Coiling Automotive



FORGING, hot-coiling, heat-treating, shot-peening, and enameling are involved in the production of automotive suspension springs at the Spring Division of the Eaton Mfg. Co., Detroit, Mich. Coil springs are made by this concern in a great variety of shapes, materials, and sizes—some so small that it requires 60,000 to make a pound, and others weighing as much as 19 pounds each. They are supplied to the automotive, aircraft, appliance, and industrial equipment fields. On the average, 750 tons of steel is used per month for hot-coiled automotive suspension springs alone.

Hot-coiled springs for automotive suspension applications are produced at this plant from hot-rolled, S A E 9260 bar stock containing 0.60 per cent carbon, 0.85 per cent manganese, 2 per cent silicon, a maximum of 0.04 per cent phosphorus, a maximum of 0.04 per cent sulphur, and the balance iron. Bar stock having a diameter of 0.547 to 0.765 inch is purchased in lengths from 120 1/2 to 178 inches long and formed into springs having an inside diameter of from 2 15/16 to 4 1/2 inches and free lengths up to 16 inches. The inside diameter of the springs is held to limits of ± 1/32 inch.

Such springs are provided with a pitch that results in from nine to ten turns in their length. They are designed for a normal load, with the car still, of from 800 to 2500 pounds, which corresponds to a load-carrying capacity of from 1000 to 4000 pounds when the springs are completely compressed. The specified load of each spring is held to a tolerance of ± 3 per cent. A typical spring having a free length of 14 inches is designed to take its normal load at a length of 9 1/2 inches, and has a closed, full-load length of 7 inches.

The ends of the springs are held square with their axes within ± 1 1/2 degrees. The springs are heat-treated to a hardness of 444 Brinell, which provides a tensile strength of 220,000 pounds per square inch with an elastic limit of 200,000 pounds

Suspension Springs

Production Methods Followed by the Spring Division of the Eaton Mfg. Co. in Converting 750 Tons of Steel per Month into Automotive Suspension Springs

per square inch, and a strength in torsion of 160,000 pounds per square inch with an elastic limit of 110,000 pounds per square inch. The minimum reduction in area is 40 per cent.

Precision-rolled bar stock having a diameter tolerance of ± 0.004 inch can be coiled without the need of a prior centerless-grinding operation. However, commercial stock having a diameter tolerance of ± 0.008 inch must be ground before the material can be processed. When this is necessary, approximately 0.020 inch is removed from the diameter of the bars by two passes through a tandem battery of two Cincinnati centerless grinders.

The bars are then taper-rolled to provide a flat seat on one or both ends of the coil spring. This forging operation eliminates the need for a grinding operation on the finished spring in cases where flat ends are required. The flat seat is made approximately 270 degrees or 3/4 of a turn, and the tapered end thickness is accurately controlled during the forging operation. A 0.660-inch diameter bar is tapered for a distance of 9 inches from the end to a rectangular cross-section approximately 1/4 inch thick. This forging of one or both ends increases the length of the bar.

The end or ends of the bar to be tapered are heated in a natural-gas fired, slot type furnace, maintained at a temperature of 1600 degrees F. The hearth of this furnace is inclined, and the bars are automatically heated to the correct temperature as they roll from the feeding end to the unloading end.

At the unloading end of the furnace, the forging operator, wearing asbestos gloves, removes a single bar at a time and places it between the motor-driven, geared, eccentric rolls of the forging machine, as shown in Fig. 1. The round-sided flat cross-section of the bar formed by the eccentric rolls is changed to a sharp-cornered rectangular cross-section by squeezing the rolled end of the bar between cam-actuated dies on the front base of the forging machine. These dies also stamp the part number on the bar, and form a hook, 1 inch from the end of the bar, with a radius equal to the inside radius of the spring. The hook serves to secure the bar to the coiling machine, and forms the tail end of the finished spring.

The forged bars are heated for the hot-coiling operation in a natural-gas fired furnace, 25 feet long by 10 feet wide, the temperature of which is maintained at 1625 degrees F. The bars are fed into one end of the furnace and are advanced in approximately twenty minutes to the unloading end by means of a "walking beam" hearth. This consists of interwoven rails, any point on which periodically travels in the path of an arc, thus lifting and advancing the bars through the furnace.

The coiling machine operator removes a red-hot bar from the furnace with long tongs and places the hooked end of the bar under a matching hook on the face of the driving head of the coiling machine. A retractable arbor of the same diameter as the inside diameter of the finished spring is advanced from the right end of the machine, or tailstock, into a recess in the driving head, and rotates with it. Directly above this arbor is a grooved lead-screw, which is gear-driven at the same speed as the arbor, but in the opposite direction. The lead-screw controls the pitch of the spring, and with the arbor, is interchangeable for various sizes of springs.

As the driving head and arbor rotate, the bar is wound, guided by the lead-screw, into the desired form of spring, as shown in Fig. 2. The arbor is then retracted, and the spring drops into a chute on the opposite side of the machine. The coiled spring is allowed to cool to approximately room temperature before it is heat-treated.

The coiled springs are heat-treated in a natural-gas overhead-fired furnace that is carefully main-

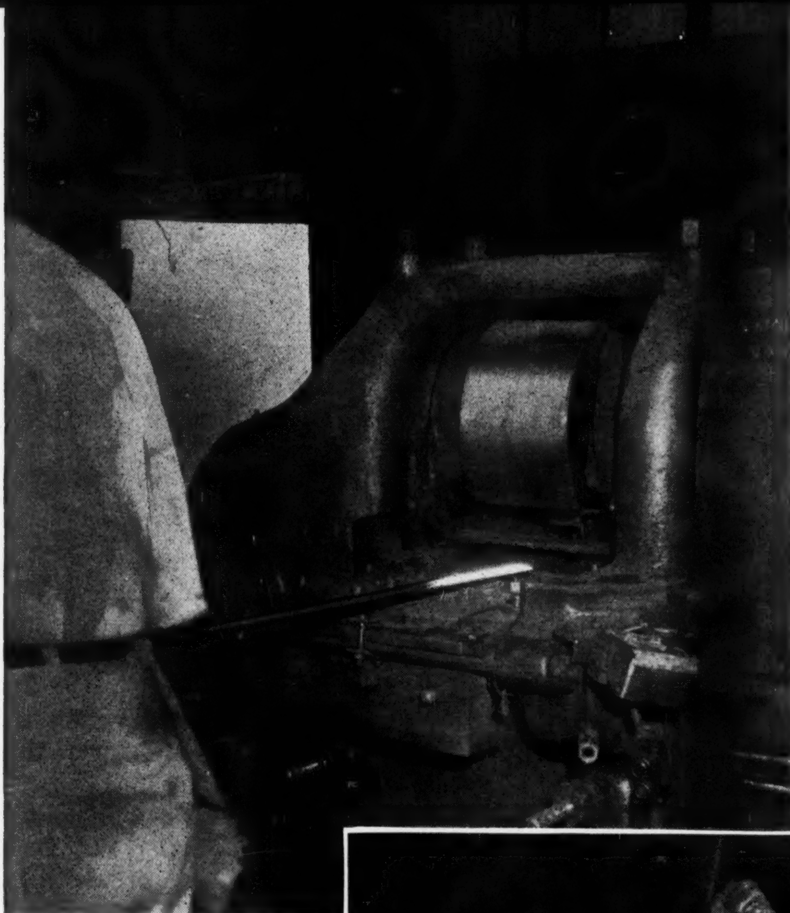
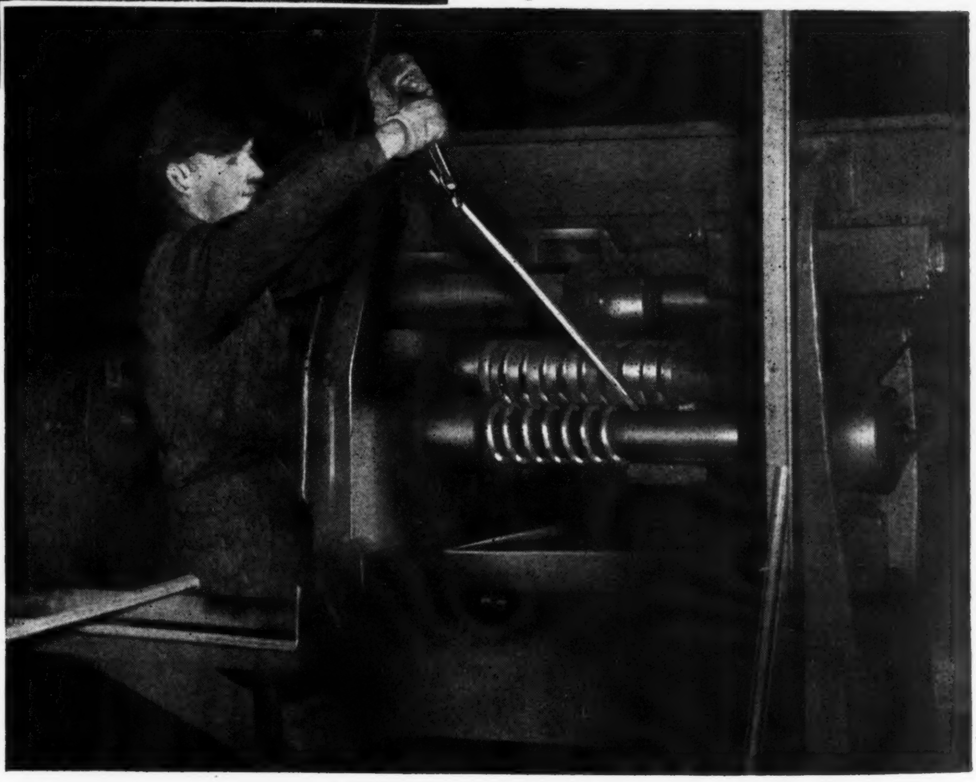


Fig. 1. (Left) To Form a Flat Seat on the End of Hot-coiled Automotive Suspension Springs, the End of the Bar is Tapered by Forging between the Eccentric Rolls of This Machine

Fig. 2. (Below) A Red-hot Bar is Wound to Form a Spring on the Rotating Arbor of This Machine. The Pitch of the Spring is Controlled by the Lead-screw Directly above the Arbor

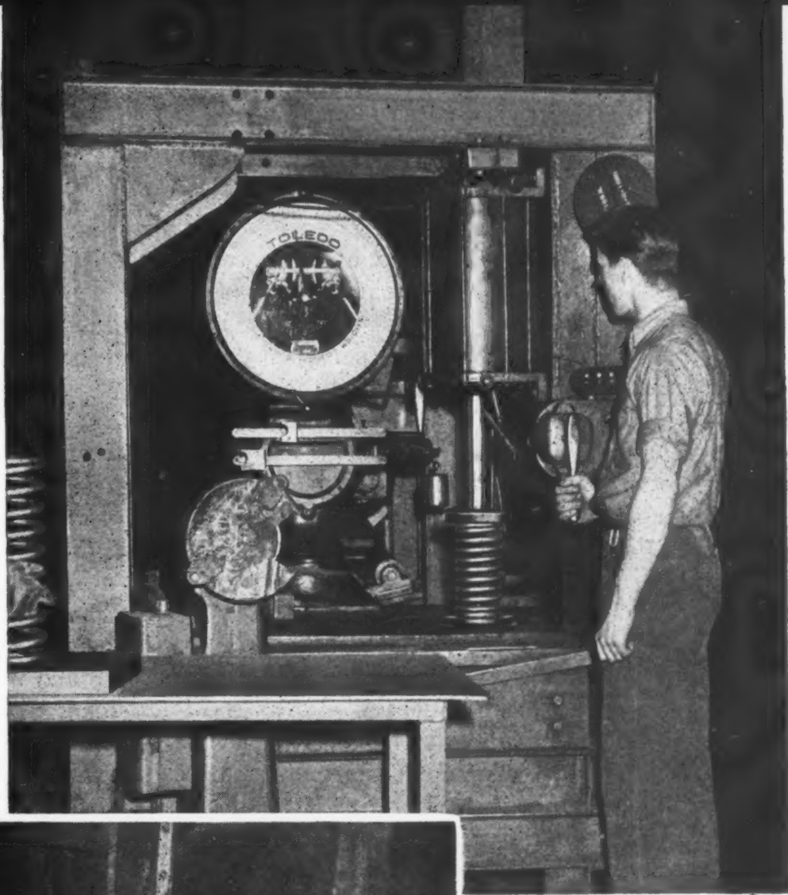


tained at a temperature of 1650 degrees F. This furnace is also of the "walking beam" hearth type, so timed that each spring is subjected to the heat for thirty minutes.

Upon the completion of the heating, the springs are unloaded from the furnace by means of tongs, and placed in the rotating quenching fixture shown in Fig. 3. This fixture has six single spring-holding stations, and is rotated and indexed by an intermittent motion which is controlled by a foot-pedal located on the floor directly in front of the quenching tank. Each station consists of an angle-iron which forms a vee in which the spring is placed. Two circular steel end-plates are advanced from each end of the station to clamp the spring and keep its ends square with the axis. A second angle-

Fig. 3. (Below) Coil Springs that have been Heated Thirty Minutes at 1650 Degrees F. are Quenched in Oil by a Rotating Fixture which Prevents Distortion and Keeps the Ends Square

Fig. 4. (Right) Equipment Used for Making Load Test on Springs. The Scale Indicates the Pounds of Force that the Spring Exerts when Compressed to a Fixed Height by a Pneumatic Cylinder



iron that forms an inverted vee is brought down on the outside diameter of the coil spring, thus firmly clamping it in the fixture and preventing distortion during quenching. Cams automatically retract the end-plates and movable angle-iron when the station has been immersed in the quenching oil, allowing the spring to fall on an overlapping steel-plate conveyor which carries it out of the quench tank. The oil in the quench tank is constantly agitated and recirculated through a spray cooling arrangement outside of the building.

The springs that have cooled to a temperature of approximately 350 degrees F. are removed manually from the quench-tank conveyor and placed in a tempering furnace. This convection-heating, indirect-fired gas furnace is controlled by pyrom-

eters to a temperature of 900 degrees F. Hot air enters the center and is drawn out of the ends of the oven. A draw of one hour and thirty minutes at this temperature will impart to the springs a Brinell hardness of 444. The temperature and time of draw are sometimes varied to suit the customer's specifications as to hardness. The springs are discharged manually from the tempering furnace and allowed to cool to room temperature.

Following the tempering, the springs are shot-peened to increase their fatigue life. Iron shot having a hardness of Brinell 600 and a diameter of from 0.023 to 0.028 inch (S A E No. P23) is used. The shot is fed by gravity from an overhead storage hopper to the center of a bladed wheel which, rotating at a high speed, hurls the shot at 200 feet per second on the springs as they are fed beneath it. The springs are placed in the cabinet of the shot-peening machine in a horizontal position on two horizontal rollers, which are rotated in a similar direction. This movement of the rollers rotates the spring about its own axis as it is pushed through the cabinet by a dog projecting up between the rolls from a motor-driven chain. All surfaces of the spring are thus subjected to the shot.

Shot-peening is essentially a cold-working process which produces strain hardening and surface changes in the springs, accompanied by induced residual compressive stresses in the outer layers. It has been found that mechanically induced residual compressive stresses in the outer surface layers are associated with pronounced gains in fatigue strength. Up to the present, shot-peening is the only effective means of obtaining these beneficial residual stresses in coil springs.

After the springs have been subjected to the shot-peening operation, they are pressed solid by the plunger of an air cylinder to increase their elastic limit and remove any tendency to shorten in height during service. A check for squareness is then made by placing the spring against a vertical post on a surface plate. The distance from the post to the axis of the spring is measured to insure that the ends of the spring are within limits of ± 1 1/2 degrees of the 90 degrees squareness required.

The springs are next subjected to a load test on a frequently calibrated, accurate platform scale. The spring is compressed by an air cylinder to a height corresponding to that for which it was designed with the automobile at rest under a normal load. The pressure of the pneumatic cylinder plunger is absorbed by a stop on the testing fixture frame, so that the load, in pounds, indicated on the scale, as shown in Fig. 4, is the actual force being exerted by the spring at this height. A hardness test on each spring has been found to be impractical, but the load test described gives a fairly accurate check of the hardness, since a spring harder than desired will not be deflected to the specified height by the load applied.

A finish is imparted to the springs by dipping them in an asphalt-base baking enamel, as shown in the heading illustration. The conveyor carries the springs through a gas-fired baking oven which is maintained at 450 degrees F. A forty-minute cycle is required for this operation—ten minutes for dipping and allowing excess paint to drip; twenty minutes for baking; and ten minutes for cooling. The springs are finally given a stripe with a hand paint-brush for identification, removed from the conveyor rack, and stacked for shipment.

Automotive Manufacturers are Geared to Set the Pace Again

THE automotive industry has labored under tremendous handicaps since V-J Day in its efforts to attain a production level commensurate with the post-war demands for its products. Despite the programs developed by management for more efficient manufacture through the construction of new plants and the installation of improved equipment, production has been disappointing to automotive executives. Strikes and more strikes have nullified management's expenditure of brains and money. Although automobile companies settle labor controversies with their own employes, strikes constantly crop up in the plants of their suppliers to delay and stop assembly-line activities.

Shortages have become so acute that one of the large automobile companies is employing thousands of men to scour the country in an effort to find essential materials. Pig iron has been shipped from Utah, Massachusetts, and even Mexico, to Detroit and its environs to keep production going. This costs plenty of money.

Although the automotive industry has fallen far short of the goal that could have been reached this year if full cooperation had been attained between Government, labor, and industry, the production aspect is by no means hopeless. As a matter of fact, the industry expects to turn out in the neighborhood of 3,300,000 cars and trucks during this calendar year. This compares favorably with the year 1939 when 3,500,000 cars and trucks were built. Considering the handicaps that had to be overcome, the record from a management standpoint is worthy of praise.

When labor and material problems have been solved, production records should soar because, technologically, the automotive industry is all set to go. Millions of dollars have been and are being spent to permit full utilization of the technical knowledge obtained in meeting war-time production problems. Labor- and time-saving methods, such as those described in this issue of MACHINERY—the annual Automotive Production number—will enable yearly production to outstrip pre-war records. Automobile plants are ready to "shift into high" just as soon as the other problems that beset the industry have been solved.

First of all, labor must see the light! It must realize that unreasonable and repeated wage increases necessarily result in higher prices for the products turned out by labor. Exorbitant prices eventually mean decreased demand, which, in turn, results in less work. Strikes hold up production not only in shops where they occur, but in the many plants that require the products of the strike-bound shops.

Only with complete cooperation between labor and management can the automotive industry effectively rally around the slogan so aptly coined by General Knudsen for the recent Automotive Golden Jubilee: "Hats off to the past, coats off to the future."

Charles O. Herb

Surplus Machines and Foreign Markets

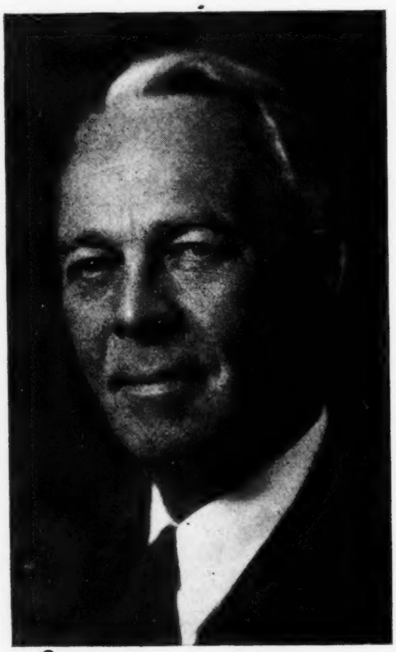
MACHINE tools having an original value of $954,537,000 have been declared surplus by the War Assets Administration so far, according to a statement made by James Y. Scott, president of the Van Norman Co., Springfield, Mass., and chairman of the Government Relations Committee of the National Machine Tool Builders' Association at the annual meeting of that Association held last month at the Chateau Frontenac, Quebec, Canada. It is believed that these machines constitute over 90 per cent of the eventual total number of surplus machine tools.

Of this surplus stock, machine tools with an original value of $257,000,000 have now been sold. It was the opinion of Mr. Scott and his committee that this enormous surplus of machine tools should be put to work in the metal-working plants of the United States as quickly as possible to replace some half-million obsolete machines still in use.

In advocating the turning over of surplus machine tools to educational institutions, Mr. Scott pointed out that "in spite of all our effort, in spite of directives, in spite of statements of policy, practically no machines have gone to the schools. Never have so many expressions of noble interest been so barren of results. First, schools were to have a 40 per cent discount. Then they were to be allowed to take machines that could not be sold commercially, and that would otherwise be scrapped. Now the thought is to charge schools 6 per cent of the original price. Why 6 per cent? Because that is supposed to cover handling costs. *The schools who most need the machines can't pay 6 per cent.* The Attorney General has ruled that the War Assets Administration can legally give surplus to non-profit educational institutions under the Surplus Disposal Act as amended, but the machine tools are *not* going to the schools."

With reference to a proper reserve of idle machine tools to be held by the armed forces, Mr. Scott said, "Unfortunately, the last session of Congress passed a law prohibiting the transfer of property from one branch of the Government to another without payment. The armed services want these reserves, but only one or two departments acted quickly enough to secure any before the passage of that act. The entire reserve of all the armed services, not including machines installed in arsenals and yards, is probably less than *one month's output* of the industry at wartime peak."

Mr. Scott commented on the intent of the War Assets Administration to scrap certain machine tools declared "commercially unsalable," as follows: "In the face of a decidedly uncertain international situation, we are destroying part of our war potential that just does not exist in our shops in times of peace, and that cannot be hastily improvised or commandeered. We machine tool builders know better than anyone how desperately hard it is to get such machines fast enough in time of war. They



Herbert H. Pease, New President of the National Machine Tool Builders' Association

Alexander G. Bryant, First Vice-president of the Machine Tool Builders' Association

L. D. McDonald, Newly Elected Second Vice-president and a Director of the Association

Discussed by Machine Tool Builders

(Left) Louis Polk, Newly Elected Treasurer and Director of the National Machine Tool Builders' Association

(Right) H. L. Tigges, Another New Director Elected at the Annual Meeting of the Machine Tool Builders' Association

should be reserved by the armed services and the best of them stored."

William P. Kirk, president of the Association and vice-president of Pratt & Whitney, in his address "Whose Reconversion?" stressed the difficulties that have been encountered through Government restrictions and labor demands in the efforts of industry to attain full reconversion. It was his opinion that "We are doomed to economic insolvency if we surrender to demagogic political and labor leadership the part that industrial leadership should take in a properly balanced system of free enterprise. It is our job in this period to stand firm on, and to preach, the philosophy of steadily increasing productivity—the philosophy upon which we have founded our business. We know it is true; we know it is right; and we know it is the one way out for America today."

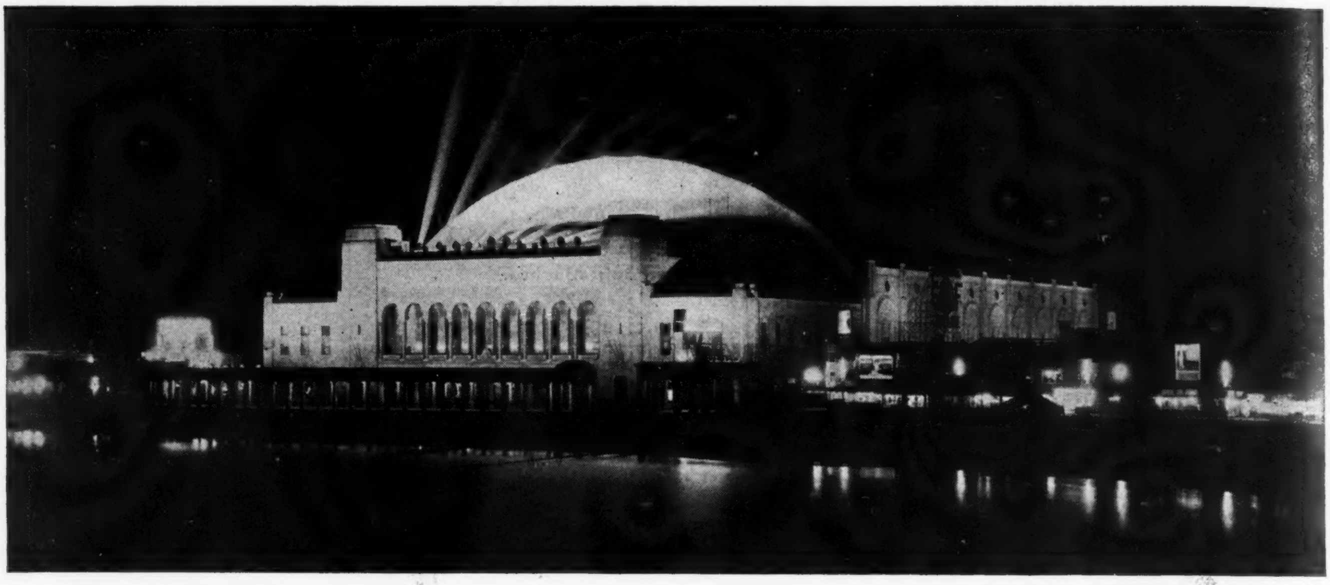
Potential market conditions in the Orient were discussed by A. B. Einig, president of the American Machine Tool Distributors' Association, and market conditions in Europe were dealt with by Nelson F. Caldwell, export manager of the Cincinnati Milling Machine Co., and Alexander S. Keller, vice-president of Pratt & Whitney. A general commentary on the Canadian machine tool industry was delivered by E. Barker, president of the Canadian Machine Tool Builders' Association.

Other papers presented at the meeting included "Price Control—The Last Lap," by Phil Huber, president of the Ex-Cell-O Corporation; "A Few Facts from the Fiscal Front," by Frederick S. Blackall, Jr., president of the Taft-Peirce Mfg. Co.; and "Report on Public Relations," by Louis Polk, president of the Sheffield Corporation. The speaker at the annual dinner was M. Grattan O'Leary, associate editor of *The Ottawa Journal.* He took as his subject "North America's Challenge and Opportunity."

The following officers of the Association were elected for the coming year: President, Herbert H. Pease, president, the New Britain-Gridley Machine Division of the New Britain Machine Co., New Britain, Conn.; first vice-president, Alexander G. Bryant, vice-president of the Cleereman Machine Tool Co., Chicago, Ill.; second vice-president, L. D. McDonald, vice-president of the Warner & Swasey Co., Cleveland, Ohio; and treasurer, Louis Polk, president of the Sheffield Corporation, Dayton, Ohio. H. L. Tigges, vice-president and sales manager of Baker Brothers, Inc., Toledo, Ohio, Mr. McDonald, and Mr. Polk were elected directors of the Association. Tell Berna continues as general manager, and Mrs. Frida F. Selbert as secretary.

* * *

The security which the American wage-earner wants is not tied to any official scheme of Government, the unions, management, or anyone else. It is a broad and comprehensive desire. As a matter of fact, the surveys show that the average American worker would prefer to work out his own problem of security without help from the employer, the state, or his union—provided only that he has steady work at good wages.—*Henry Ford II*



National Metal Congress and Exposition

ATLANTIC CITY, NOVEMBER 18-22

THE twenty-eighth National Metal Congress and Exposition, scheduled to be held in Convention Hall, Atlantic City, N. J., November 18 through November 22, promises to be one of outstanding interest and value to the metal-using industries. The exhibition, which is sponsored by the American Society for Metals, with headquarters at 7301 Euclid Ave., Cleveland 3, Ohio, has over three hundred manufacturers registered who will display and demonstrate the latest developments in metals, equipment, and processes.

Exhibits of ferrous and non-ferrous metals and alloys, as well as equipment for processing, welding, fabricating, testing, and inspecting metals will occupy the main auditorium and exhibition floors of the huge Convention Hall.

More than sixty papers have been listed for presentation on the program of the technical sessions to be held by the American Society for Metals in conjunction with the exposition. Two technical meetings will be held daily during the exposition in Convention Hall, beginning at 10:00 A. M. and at 2:00 P. M.

Some of the subjects to be dealt with at these sessions are as follows: Development of an Alloy for Turbosupercharger Buckets; Metallographic Techniques for Magnesium Alloys; Calculation of Press Forging Pressures and Application to Magnesium Forgings; Plastic Deformational Analyses on Pure Magnesium; The Cold Work-Hardening Properties of Stainless Steel in Compression; The Precipitation Heat-Treatment of Work-Hardened 61 SW Aluminum Alloy; New Wrought Zinc Alloys Containing Small Amounts of Beryllium; Bainitic Hardening of High-Speed Steel; The Tempering of High-Alloy Tool Steels; Changes in Size and Toughness of High-Carbon High-Chromium Steels Due to Sub-Zero Treatments; X-Ray Study of the Effect of High Hydrostatic Pressures on the Perfection of Crystals; Formation and Transformation Studies of Iron-Carbon Powder Alloys; Decarburization during Annealing of Malleable Iron; Folding in the Cupping Operation; Development of Temper Brittleness in Alloy Steels; Cast Heat-Resistant Alloys of the 16 per cent Chromium, 35 per cent Nickel Type; A Study of Furnace Brazing as Applied to 12 per cent Chromium Low-Carbon Steel; The Interrupted Quench and Its Practical Aspects; Experimental Studies of Continuous Cooling Transformations; Influence of the Strain Rate and the Stress System on the Mechanical Properties of Copper; Copper-Manganese Alloys—the Properties of Cold-Worked and Annealed Alloys Containing 2 to 20 per cent Manganese; Age-Hardening of Copper-Cobalt-Manganese Alloys; Mechanical Properties of Cast Low-Alloy Steels; The Measured Knoop Hardness of Hard Substances, and Factors Affecting Its Determination; Hardenability of Shallow Hardening Steels Determined by the PV Test; Hardness Test-

ing of Metals and Alloys at Elevated Temperatures; Metallurgical and Structural Investigation of Steel Castings for Aircraft; The Effect of Manganese on the Properties of Cast Carbon and Carbon-Molybdenum Steels; Practical Importance of Hydrogen in Metal Arc Welding of Steel.

On the program for the annual meeting of the American Society for Metals, scheduled for 10:00 A. M. November 20, is listed the Edward de Mille Campbell Memorial Lecture by J. B. Austin, United States Steel Corporation.

The program for the four lecture courses conducted daily during the exposition includes three lectures on The Structure of Cast Iron; eight lectures on Electronic Methods of Inspection of Metals; five lectures on Physical Metallurgy of Aluminum; and six lectures on Sleeve Bearing Metals.

Presentation of the Albert Sauveur Achievement Award; the ASM Medal for the Advancement of Research; and the Henry Marion Howe Medal will be a feature of the annual banquet of the Society to be held at the Traymore Hotel.

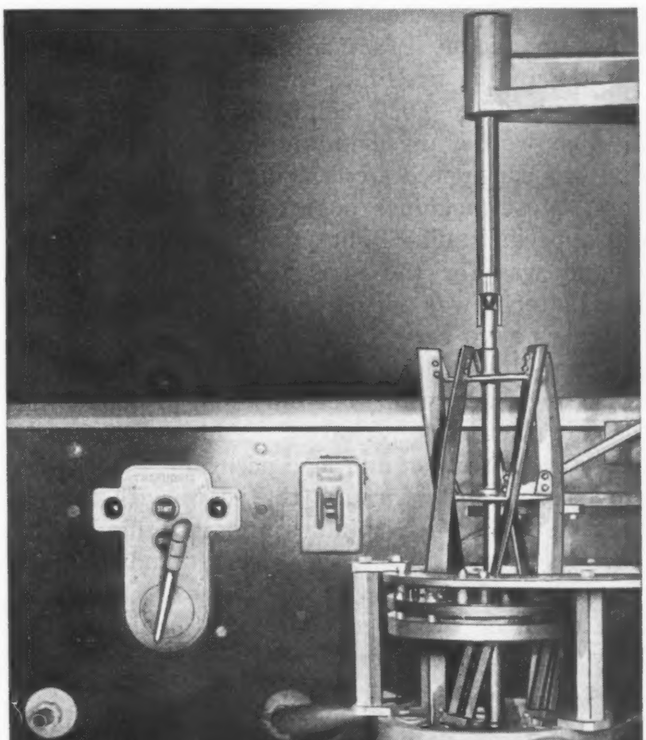
Cooperating societies holding sessions in Atlantic City during the exposition include the American Institute of Mining and Metallurgical Engineers, American Welding Society, and the American Industrial Radium and X-Ray Society.

Warpage of Mower Blades Reduced and Production Increased by Induction Hardening

INDUCTION heating is especially applicable to parts that must be hardened without deformation, as, for example, the blades of lawn-mower reels. In the application here shown, the equipment for which was designed by the Induction Heating Corporation, New York City, the five blades on a lawn-mower reel assembly are hardened simultaneously in one minute by progressively feeding the assembly through a solid type induction heating coil and into a spray quench. The heat is confined to a 3-inch longitudinal section of the blades, and the heated portion is quenched immediately upon leaving the heating coil. No appreciable scale results from this process, and distortion of the work is negligible.

Prior to installing induction heating equipment, the manufacturer of these lawn mowers formed and hardened the blades before assembling them to spiders on the reel. Hardening of the unassembled blades was performed by heating in a large-capacity gas furnace, followed by oil quenching. This method, on account of special conditions, involved a high unit cost for short-production runs. In addition, a high percentage of uncontrolled warpage and consequent heavy scrap loss, resulting from the previous process of hardening the entire blade in a furnace, is eliminated by induction heating. This is accomplished by hardening a portion of the cutting edges only without altering the original state of toughness and ductility in the blade cores. A hardness of 65 Rockwell C, confined to the outer 1/4 inch of the cutting edges, is obtained with SAE 1045 steel.

Under present operating conditions, the blades are machined, ground, and assembled before being mounted in the fixture. Control of the 20-kilowatt, 375-kilocycle generator is by means of start-stop buttons mounted on the front of the cabinet, and the entire hardening operation is performed automatically, thus permitting the use of unskilled help. Production is at the rate of sixty five-blade reel assemblies (300 blades) per hour.



A 20-kilowatt, 375-kilocycle Induction Generator Provided with Automatic Work-handling Equipment Surface-hardens Sixty Mower Reel Assemblies per Hour

Thread Grinding with Crush-Dressed and Diamond-Dressed Wheels

Abstract of a Paper Presented before the Recent Boston Meeting of the American Society of Mechanical Engineers by Ernest V. Flanders, Chief Engineer, Thread Grinder Division, Jones & Lamson Machine Co., Springfield, Vt.

GRINDING wheels have been formed by the so-called "crushing method" for many years, both experimentally and practically. As a matter of fact, this process probably was used in one form or another over twenty-five years ago, but the wheels thus formed were only a small percentage of the total number of formed wheels used. The diamond was the accepted means of forming or truing a wheel to the desired shape at that time. Furthermore, up to the early 1930's form grinding or thread grinding was, with few exceptions, considered a finishing operation only.

The largest users of grinding wheels for ground thread forms were the small tool and gage manufacturers, who employed them in manufacturing taps and thread gages and in grinding chaser teeth for automatic die-heads. Accuracy was the most important factor. Practically all work was brought to the grinding machines roughed out, an average of from 0.015 to 0.020 inch being left for grinding. In other words, any grinding operation in this period was considered a rectifying or clean-up operation. Most machines operated at relatively high work speeds, taking light cuts. The material being ground was for the most part high-speed steel. This material was not hard to grind. Wheel manufacturers were very successful in producing standard grinding wheels for the service they were called on to perform. The only real problems that the manufacturer of grinding machines had to meet were those of finish and lead accuracy. These improved constantly through the years with the improvement of wheel-spindles and machine design.

In the early 1930's the aircraft industry demanded something better in the way of threads than could be produced by conventional methods. They were large users of heat-treated alloy steel parts and were demanding a quality of thread on such parts as studs, crankshaft bolts, prop shafts, and cylinder barrels that could be obtained only by grinding. In order to meet this need, thread grinders of more modern design had to be produced—machines that were massive and had ample power for the wheel drive, used much larger wheels, and were semi-automatic in operation. These machines, in most cases, no longer required the work to be pre-threaded.

A completely new technique in grinding from the solid was developed. Instead of using high work speeds and light cuts, low work speeds were used with very heavy cuts. Hand in hand with this development came new types of wheels which were run at surface speeds as high as twice the accepted normal speed of 6000 feet per minute. The combination of these developments, together with an automatic wheel-truing device that removed all guesswork as to the thread form, made it possible to produce high-grade threads very rapidly. This was true not only of aircraft parts made of alloy steels, but also of the threads on taps and gages; it became commonplace to grind the majority of these parts from the solid in one or two passes without the necessity of a pre-threading operation.

Much was learned about the type of coolant that worked most effectively with grinding wheels, and the way in which this coolant should be applied. This, in itself, was an important step in the development of thread grinding on a production basis. Large-diameter, diamond-dressed wheels of the resinoid type, combined with accurate control of the coolant in sufficient quantity to effectively lubricate and cool the work, produced accurately ground threads in large quantity.

The closing years of the war saw the introduction of the so-called "multi-ribbed" wheel. This is a development that would naturally follow the perfection of grinding by the single-ribbed process. The new type wheel broadened the useful field for ground threads. Obviously, if a 12-pitch thread, 1 inch long, is ground with a single-ribbed wheel, it will take much longer to grind than if it is ground with a multi-ribbed wheel having twelve ribs working all at once.

One of the first important jobs for multi-ribbed wheels was that of grinding the taper threads on the end of rock drills and tool joints for the petroleum industry. This thread is too long to be ground by a wheel as wide as the thread is long. However, it was a simple matter to produce a wheel that had three ribs—the first a roughing, the second a semi-

finishing, and the third a finishing rib. Work with five threads per inch is now ground from the solid in one pass. The grinding time is one-third the former milling time and a much more accurate thread, with a better finish, is produced.

In designing a truing device for diamond dressing multi-ribbed threads, it has been found advisable to dress only every other rib. The reason for this is that it allows the use of a more substantial diamond. This means that when a thread is to be ground it will be necessary for the work to travel two and a fraction revolutions rather than one and a fraction, as would be the case if every rib were dressed. The two methods are designated "skip" rib and "full" rib dressing. The multi-form device was designed to operate efficiently in connection with the resinoid type wheel which had developed as the great production thread grinding wheel during the war years. The threads ground by this process were immediately successful, and were found to be well within Class III specifications; grinding speeds of from 2 1/2 to 3 feet per minute on the work became accepted practice.

The use of wide wheels, up to 2 inches, requires considerable horsepower for driving the wheel-spindle. It is not at all uncommon to use a 20-horsepower motor for this service. This motor is always a direct-current, variable-speed type, so the proper cutting action of the wheel can be maintained.

In the meantime, crush-dressing came to the front. This type of wheel forming had been widely used in Europe for some time. As a matter of fact, the two types of wheel truing referred to were in competition in France before the war.

In experiments conducted with a 220-grit wheel having a hardness range of K, L, or M, it was found, among other things, that the form of the crusher roll was not materially altered as long as good contact under pressure was maintained between the roll and the wheel. The material used in the rolls was high-speed steel with a normal hardness range of 63 to 65 Rockwell C. A pressure range of 100 to 150 pounds per square inch worked best. This is in the neighborhood of from 400 to 600 pounds total pressure of roll against wheel, the wheel being 1 inch wide. When more pressure was used, the crushing action was faster, but not so accurate. When less pressure was used, the crushing action proved to be slower, and there was a decided tendency for wear to develop on the crusher roll.

It is not claimed that this series of tests gives all the answers, but it is believed that they point the way toward increased production of ground thread parts and show what can be expected from different types of dressing of multi-ribbed wheels.

All the experimenting was done on work with twelve threads per inch. It was learned that there is considerably more wear of the crusher roll in recrushing operations than in the original crushing of the wheel. Experience finally indicated that the length of time that the crusher roll was in contact with the wheel on the recrushing operation was very critical. If not enough time is allowed, there is not a complete crushing, which, on a machine with automatic sizing, means that size control, as well as the form is sacrificed. On the other hand, if the wheel and crusher roll are allowed to roll together a few seconds longer than is necessary, undue wear occurs and the crusher roll form deteriorates rapidly. It is therefore necessary to time the recrushing cycle very closely. When this is done, a wheel can be recrushed from fifty to seventy-five times with almost no sign of wear on either the crusher roll or in the wheel form.

Having determined the most satisfactory crushing technique for the type of grinder and spindle used, numerous tests were made. These tests led to the following conclusions: It is easier to set up for multi-rib grinding with a diamond truing device, as there is only one diamond and one former. The diamond is accurately and rigidly held in place, and resetting the diamond tools does not disturb the total set-up to any great extent. The diamond maintains a better form on the wheel, due to the fact that the wear is relatively small and the inaccuracies produced are of little consequence.

It was also concluded that a diamond-dressed resinoid wheel produces a better average finish than can be obtained from a crush-dressed vitrified wheel. This is due to the burnishing or polishing action inherent in the grinding action of the resinoid type wheel. The diamond dressing device will allow the user to grind finer pitch threads than seems to be possible by the crush-dressing method. There is no difficulty in obtaining the basic form of forty threads per inch with this type of dressing. If needs require, it is probable that even finer threads could be ground. Finally, it is believed that a diamond-dressed wheel gives better size control over repeated dressings than a crush-dressed wheel.

Now for the advantages to be claimed for crush dressing. In the first place, crush dressing gives a greater angle range than is possible with diamond dressing equipment. The multi-rib diamond truing device can dress any thread form having a flank angle greater than 22 1/2 degrees, measured from the vertical. That means that there are certain types of threads, such as worm, Acme, and buttress, that cannot be produced by diamond dressing. Some of these, however, can be taken care of by crush dressing, which can be performed within 5 degrees of the vertical, as far as flank angle is concerned.

Second, with proper technique, a new wheel can be crushed to form more quickly than it can be diamond dressed to the same form. This is due to the fact that one works on the full width of the face in the crushing operation, whereas the

diamond must travel back and forth across the face, taking relatively light cuts. Third, there is less tendency to discolor the work in using a crush-dressed wheel than in using a diamond-dressed wheel, although this discoloration is largely due to oxidation of the grinding oil and has seldom been found to be injurious to the material.

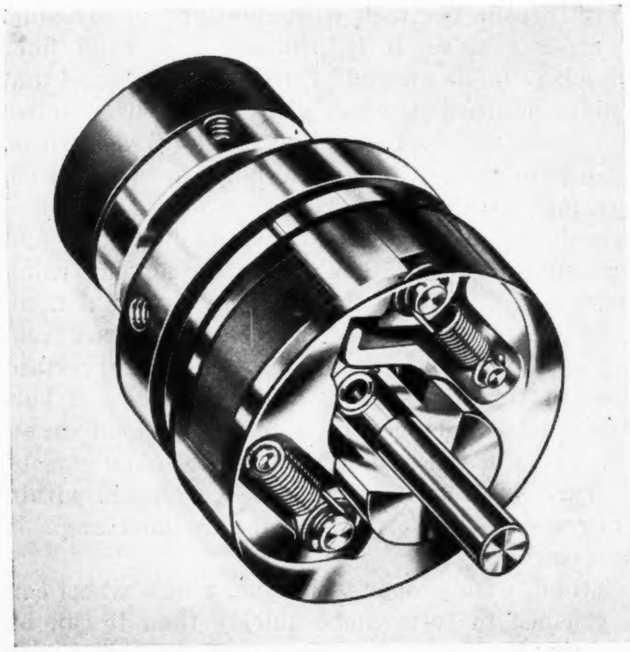
Fourth, the crush-dresser allows the crushing of full-ribbed wheels, which means that the work need not rotate as rapidly in order to produce a finished piece in a given length of time as is the case with a resinoid type wheel that is dressed by the skip-rib method. However, on that class of work where full ribs can be dressed on the resinoid type wheel, the latter again becomes the faster producing wheel.

There are a few disadvantages in the use of crush dressing that are not met with in diamond dressing. The crushing roll must be carefully centered on the grinding wheel, making certain that no partial thread is crushed into the edge or corner of the wheel. This leads to a flaking that may materially alter the sides of the wheel if not taken care of immediately. Also, any variations in the hardness or density of the wheel structure have a marked effect on the way the wheel crushes, and as a consequence, on the finish ground on the work.

In conclusion, it may be pointed out that while the crush-dressed vitrified wheel has not displaced the diamond-dressed resinoid wheel as the most efficient type for maximum stock removal, it does become a real competitor with the resinoid wheel in multi-ribbed thread grinding. The vitrified wheel has certain characteristics that make it advantageous for use on multi-ribbed work, where the specifications are for Class III or less accuracy. Vitrified crush-dressed wheels can now be run at higher surface speeds than formerly. This allows an increase in the work speed to such an extent that it puts the vitrified wheel in competition with the resinoid type. Tests will be continued to throw more light on this important subject.

Friction Clutch Operated by Centrifugal Force

IMPROVED oil-burner combustion efficiency is attained by means of an unusual automatic friction clutch that is operated by centrifugal force. With this clutch, which is made by the Gilbert & Barker Mfg. Co., West Springfield, Mass., the fan of the oil burner is revolved before the fuel pump starts, and continues to rotate for a short time after the pump stops.



Phantom View of Automatic Friction Clutch that is Operated by Centrifugal Force

The motor shaft of the oil burner is flexibly coupled to the fan hub and clutch shaft to eliminate vibration. A pilot on the opposite end of the clutch shaft is mounted in a bearing pressed into the hub of the clutch drum, thus insuring alignment and free running. Two weights with special cork facings are mounted on the clutch shaft within the drum. The clutch is engaged when the centrifugal force is great enough to cause the weights to pivot on bearings fitted over studs on the clutch plate, thus causing the cork facing to contact and drive the inner periphery of the clutch drum rim. The speeds of the motor shaft at which the clutch will engage or disengage can be controlled by the tension springs with which the pivoted weights are connected to the clutch plate. The hub of the clutch drum is attached to and thus drives the pump shaft.

In operation, when the motor starts, the fan, clutch back-plate, and weights make several revolutions before sufficient speed and centrifugal force are attained to engage the clutch drum and drive the fuel pump. Thus, air is provided ahead of the oil in starting, insuring complete combustion without soot or smoke.

When the current is interrupted, the clutch drum is disengaged and the oil-pump stops. However, the fan, motor, and clutch weights, relieved of the pump load, continue to revolve due to momentum. Thus, for several seconds after the oil flow is stopped, air continues to flow into the combustion chamber to consume any residual smoke or oil vapor that would form soot on the heat-absorbing surfaces.

The Role of Casting in Engineering Production

By C. R. AUSTIN
Meehanite Metal Corporation, New Rochelle, N. Y.

Abstract of a Paper Read before the Recent Fall Meeting of the American Society of Mechanical Engineers in Boston

WHAT may be termed "engineered castings" depend, for their successful service application, not on any one fact alone. For production engineering, it is important to consider many aspects of the subject. Among these the following are of major importance:

1. The selection of the proper iron in relation to casting section and to mechanical properties demanded.
2. The basic engineering properties of the iron in relation to the service demanded.
3. The manner in which these specific properties can be utilized in designing castings.

Selecting Iron in Relation to Casting Section

At first sight, the problem of the relation between the material and the casting section might be considered of little importance to the production engineer, but since he usually has the important duty of specifying the metal to be employed in his product, it is essential to give some attention to this matter. In non-ferrous metals, he is concerned merely with the chemistry of the alloy, and consequently specifies an alloy of a given analysis, with known and readily defined properties having little relation to casting section.

With cast irons, the problem is different, since the two following factors must be considered:

1. The structure and properties of cast iron depend on the rate of cooling during solidification, and hence on the section of the casting and its location in the sand mold into which the metal is to be poured.
2. The outer peripheral parts of heavier iron castings are ordinarily more dense than the inner parts, where solidification takes place more slowly. It is common experience to find that the interior of heavy gray iron castings has a porous open structure and such low density, compared with the exterior parts, that there is a great decrease in hardness and tensile strength of the iron.

These facts have been thoroughly recognized, and a brief reference to Meehanite practice, whereby control of both these variables can be effected, is needed in order that the engineer may have some understanding of its importance in specifications.

Two totally different cast irons, gray and white, are easily recognized by the engineer. The properties of the former are indicated by low hardness and good machinability, and the structure consists of flake graphite distributed in a matrix of pearlite and free ferrite. The properties of the latter are identified by high hardness, brittleness, and non-machinability, and the structure consists of massive free carbides or cementite and pearlite.

Fortunately for the user of gray iron castings, some control of the "grayness," and hence of the

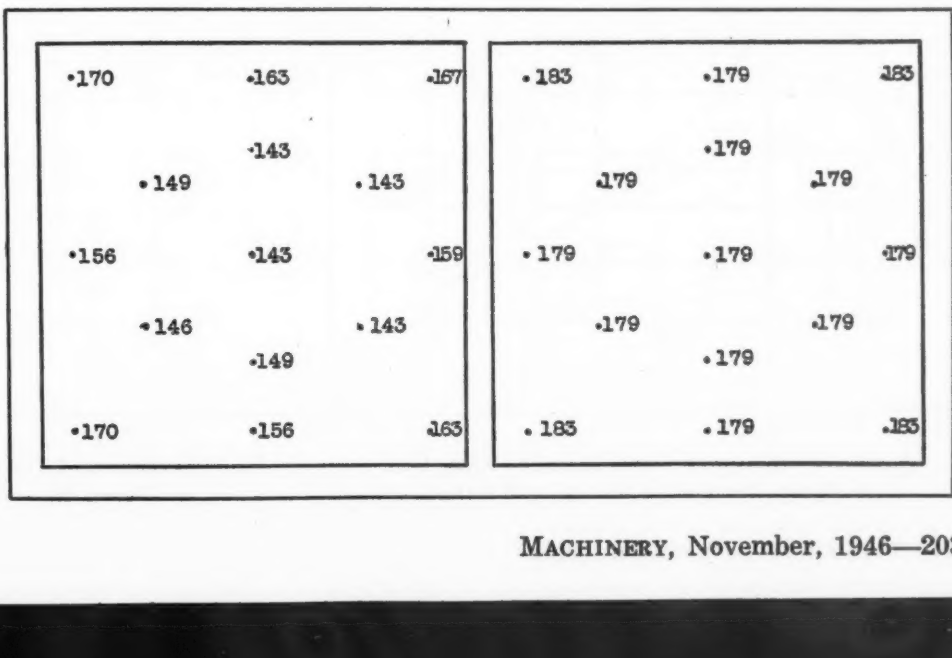


Fig. 1. Brinell Hardness Readings at Various Locations on Transverse Sections of 12-inch Square Blocks of Cast Iron. The Block at the Left is Gray Iron, and the Block at the Right is GB Meehanite

properties of the iron, is available by what may be termed balancing the analysis of the irons. Thus, in thin sections, which often yield brittle white irons because of rapid cooling, an increase in silicon content is made to insure a gray fracture despite the high cooling rate. This procedure, however, has a deleterious reaction on the structure of heavy sections, which solidify with a coarse, porous structure.

It is control of the nature of the matrix, along with solidity penetration, which is so vital to the engineer demanding both constancy and uniformity of properties, independent of the section. No scientific means of control has been available to the gray iron foundryman whereby he could produce an engineering iron in any positive or definite manner. This fact has clearly been the cause of the vagaries in the properties of cast iron which have caused the design engineer to look elsewhere for his materials of construction.

As a result of much carefully planned and extensive research, it is now possible to control the structure of irons independently of casting dimensions without seriously changing the silicon content. This control is effective because of what has been termed a "two-step" process in castings. Step 1 consists in computing and suitably preparing a charge of iron and steel which can be melted to a liquid having a direct relation, in terms of carbide balance, to the amount of primary carbide formed in the solidified casting.

Step 2 is concerned with the controlled decomposition of the primary cementite, with the object of insuring a metal matrix consisting wholly of pearlite without free cementite or free ferrite. Furthermore, control in size and distribution of the graphite is effected so that in the higher engineering type of Meehanite irons the cast structure may be likened to that of a normalized tool steel which contains uniformly distributed fine and short flake graphite.

Having established the means of controlling structure—and hence mechanical characteristics—it became necessary to control structure in terms of the dimensions of the castings. It was discovered that there is a direct relation between the constitution of the iron and the thickness of the section of the casting to be made, and that it is possible to establish a ratio between what have been termed the constitutional and process wedge values in each casting which will insure uniformly dense sections and predetermined engineering properties. This is of vital significance to engineering production, and it must be recognized if the engineer is to make the best use of the materials now at his disposal. A few examples should aid in stressing its importance.

If a 12-inch square block of gray iron is cast and then sectioned transversely, it is well known that the center will be much softer, because of its more open structure, than the outer parts of the casting. On the other hand, by correlating the constitution of the iron with the section to be cast, essentially uniform hardness can be insured from center to surface. This fact is demonstrated by the data shown in Fig. 1.

An examination of the tensile strength in relation to casting section also demonstrates the importance of mass influence. In an ordinary gray iron, cast in sections varying from 1 to 4 inches, the relation between the tensile strength and the casting section may be somewhat as shown in Fig. 2. By controlling the foundry practice, the relation becomes similar to that shown in Fig. 3.

In order to insure these property controls, high quality foundry technique and control are absolutely necessary. It is the duty of the producer of castings to constantly exercise control over the

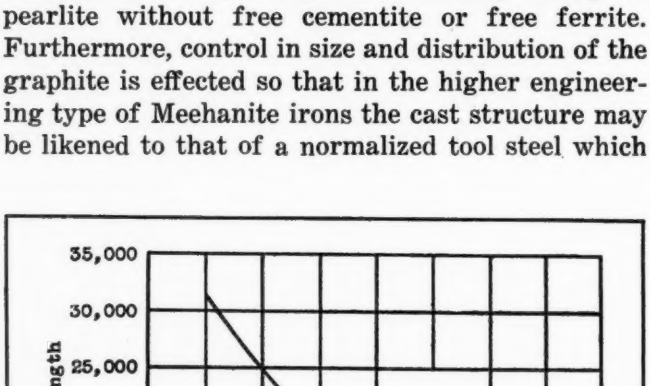


Fig. 2. Relation of Tensile Strength of Gray Iron to Casting Sections of from 1 to 4 Inches

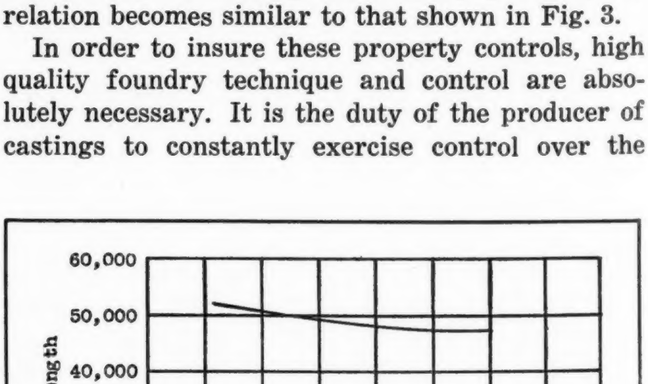


Fig. 3. Relation of Tensile Strength of GA Meehanite to Casting Sections of from 1 to 8 Inches

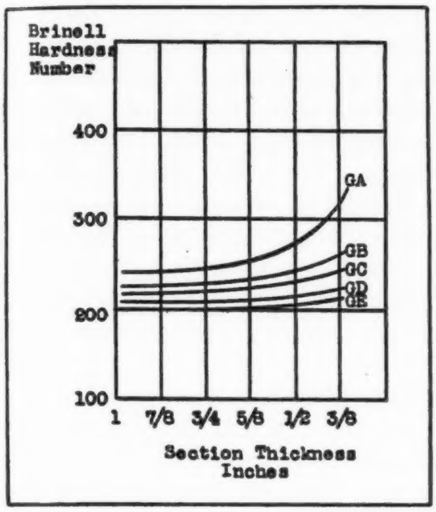
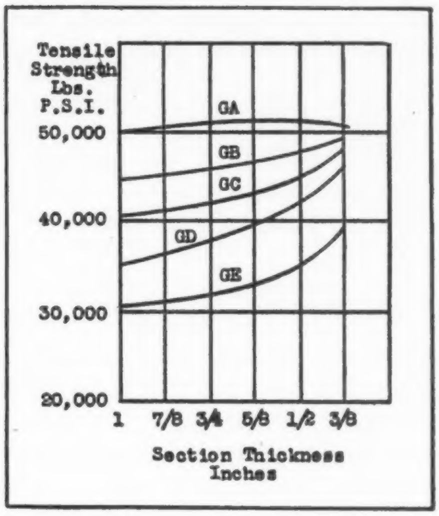


Fig. 4. (Left) Graph Showing Increasing Hardness of Various Types of Meehanite with Decreasing Section Thickness

Fig. 5. (Right) Graph Showing Variation of Tensile Strength with Decreasing Section Thickness



product and advise as to the type of metal most suited for any engineering production job. Nevertheless, there can be intelligent cooperation between the foundry and production engineer only if the latter has some knowledge and appreciation of the problems of the former and realizes that there are now available for his use "tailor made" iron castings produced to do a specific engineering job. The need for this cooperation has long been recognized in the fabricated steel industry, but it is only recently that the production engineer or metallurgist and the utilization or design engineer have really begun to work together.

In Meehanite practice, the selection of the right material has been largely simplified for the production engineer by engineering type designations GA to GE with tensile strengths ranging from 50,000 to 30,000 pounds per square inch. Higher tensile strength irons are designated GM. Iron designed for wear-resisting, corrosion-resisting, and heat-resisting applications is outside the scope of this discussion.

Specification is certainly one of the most important duties of the design or production engineer. The relation of Brinell hardness and tensile strength to section thickness in the various types of engineering irons is shown in Figs. 4 and 5. Types GD and GE can be poured in thin sections, 3/8 inch or less, and still retain their grayness or free machining qualities, along with excellent tensile strength. If GA is poured in a casting of less than 1/2-inch section, its strength is decreased and machining problems may result.

An engineer may have a particularly important casting in which he desires high tensile strength, and consequently specifies GA Meehanite. This specification is correctly made if the casting sections are relatively heavy. However, if Type GA is employed for a casting having a 3/8-inch section, a loss of tensile strength may result and machining problems are sure to arise. In such a case, GC will be found to give good tensile strength, high hardness, and free machinability.

Fortunately, the modern foundry is equipped to advise on these matters, and it is only necessary for the production engineer to be aware of the newer products at his command and the need and reason for consultation with the foundry metallurgist or engineer.

Basic Engineering Properties

Until recent years, cast iron was not considered a true engineering material, which could be utilized on a design basis. Little thought was given to its application in members for service at elevated tem-

Table 1. Minimum Physical Properties of Various Types of Meehanite

Type Meehanite	Tensile Strength, Pounds per Square Inch	Transverse Strength Test, 1.2" Dia. Bar, 18" Centers		Brinell Hardness	Compression Strength, Pounds per Square Inch	Modulus of Elasticity	Fatigue Strength, Pounds per Square Inch	Specific Gravity
		Load, Pounds	Deflection, Inch					
GA	50,000	3100–3600	0.28–0.34	207	175,000	21,000,000	22,000	7.31
GB	45,000	3000–3400	0.28–0.34	196	160,000	19,000,000	19,000	7.28
GC	40,000	2900–3300	0.26–0.34	192	150,000	17,500,000	17,500	7.25
GD	35,000	2600–3000	0.22–0.34	183	130,000	15,000,000	15,000	7.22
GE	30,000	2000–2600	0.20–0.34	174	120,000	12,000,000	13,700	7.16

Table 2. Comparative Tensile Strength of Gray Cast Iron and Meehanite in Relation to Section Thickness

Section of Casting Tested, Inches	Tensile Strength, Pounds per Square Inch	
	Gray Cast Iron	GA Meehanite
0.75	27,500	......
1.25	25,500	53,500
2.00	18,400	54,000
3.00	15,200	53,000
4.00	......	50,800
6.00	......	47,500

peratures, where loads of a given magnitude had to be maintained and plastic flow controlled within predetermined limits.

The old concept that cast iron was a brittle material without elastic properties is certainly no longer true of modern irons, which can be made with accurately known and reliable properties. In Table 1, the general engineering specifications for the various types of Meehanite are given. These values represent the minimum physical properties at normal-temperature operation. The maintenance of tensile strength, independent of casting section, is also important. Data on this point are given in Table 2.

An important property of a metal is its toughness. Considerable experimental analysis has been carried out relative to this property, and no test is yet available which provides a satisfactory measure of toughness. For fabricated steels, an Izod or Charpy value on a 10-millimeter square test bar has usually sufficed. For tool steels, however, such tests are meaningless, and resort has been made to torsion impact tests. In the study of irons, a modified Izod impact test made on an unnotched test piece machined to 0.798 inch diameter seems to have found rather general favor. Table 3 gives data obtained in an extensive investigation on the toughness of general engineering types of Meehanite.

The fatigue strength of a metal is also a very important characteristic of metal parts, and data are available for the various irons here discussed. Using the standard R.R. Moore type of fatigue-testing specimen and machine, values ranging from 22,000 pounds per square inch for GA Meehanite

Table 3. Results of Modified Izod Impact Tests on 0.798-Inch Unnotched Test Bars

Type Meehanite	Impact, Foot-pounds to Fracture
GA	25–35
GB	15–23
GC	12–20
GD	8–15
GE	6–12

down to 13,700 pounds per square inch for GE Meehanite irons have been established.

As the operating temperature of unit parts is progressively increased, the results of normal-temperature basic engineering tests become decreasingly significant. For this reason, creep studies have been developed extensively in recent years, so that the design engineer may have specific knowledge of the behavior of materials at various temperature levels when subjected to defined stress conditions. A vast amount of data has thus been accumulated on the behavior of fabricated steels and special alloys, but little information is available on the creep properties of cast irons. During the last few years many creep tests have been conducted on the various types of Meehanite which are of direct interest to the design engineer.

The effect of temperature on ultimate strength and elastic modulus of GB Meehanite is shown in Table 4. Up to temperatures as high as 700 degrees F., the tensile strength shows some increase.

Table 4. Effect of Temperatures on the Ultimate Strength and Elastic Modulus of GB Meehanite

Temperature		Ultimate Strength, Pounds per Square Inch	Modulus of Elasticity
Deg. C.	Deg. F.		
15	60	54,000	19,200,000
230	445	57,000	18,300,000
250	480	57,000	—
300	570	59,000	17,800,000
350	660	57,200	—
400	750	46,200	14,400,000
490	915	27,900	10,600,000
590	1095	21,100	—

As the temperature is further increased, the tensile strength progressively drops. It is well recognized, however, that the creep characteristics of metals are a more reliable index of their high-temperature strength, and such data furnish the engineer with information required for designing.

Iron Castings in Engineering Production

The application of iron castings in engineering production covers a wide field, which has been greatly extended during the war on account of the burden imposed on steel foundries and forging shops. Because of war exigencies, it became necessary for the design engineer to look for other facilities and materials. Fortunately, the engineer soon learned that cast irons were available which replace even with advantage, many of the parts that he became accustomed to specify in fabricated steel or other material.

Thus replacement was made in a wide variety of applications, such as pressure-resistant parts for

steam, gas, oil, and water; sliding surfaces subject to friction where minimum galling tendency was necessary; crankshafts and cutter bodies subject to vibration where effective damping and high fatigue strength were required; heat-treated parts were high hardness or wear resistance was essential; and many other applications where varied property characteristics had to be maintained at elevated temperatures.

Applications of heat-, wear-, and corrosion-resisting cast iron were extensive even before the war. Few fields of engineering remained in which the engineer, although rightly conservative, had not benefited by adopting these castings.

Despite the economies of the substitution of cast parts for fabricated parts, nothing is gained unless the new material provides properties at least comparable to those of the material replaced. In many instances, however, a much greater service life was obtained.

In machine and machine tool applications, the wide adoption of castings has been the inevitable result of increased experience and better recognition of their engineering properties and reliability as demonstrated in service. In collets and holding fixtures, for example, the elastic properties of cast iron are utilized. In order to achieve the necessary spring temper, collets are heat-treated after machining. In one case, cast iron replaced a part previously machined from a bar of S A E 1045 steel.

The use of cast iron in tool shanks and milling cutter bodies has resulted in increased vibration absorption, combined with strength, rigidity, and better heat conductivity. By casting the shanks and cutter bodies closely to shape, machining operations are reduced and greater flexibility in design is provided.

For many years, cast iron has served as a successful die material for four reasons:

1. Cast dies can be made close to dimensions, thus reducing required machining and expensive built-up construction.

2. The graphite content of these iron dies provides self-lubrication in service, thus increasing die life.

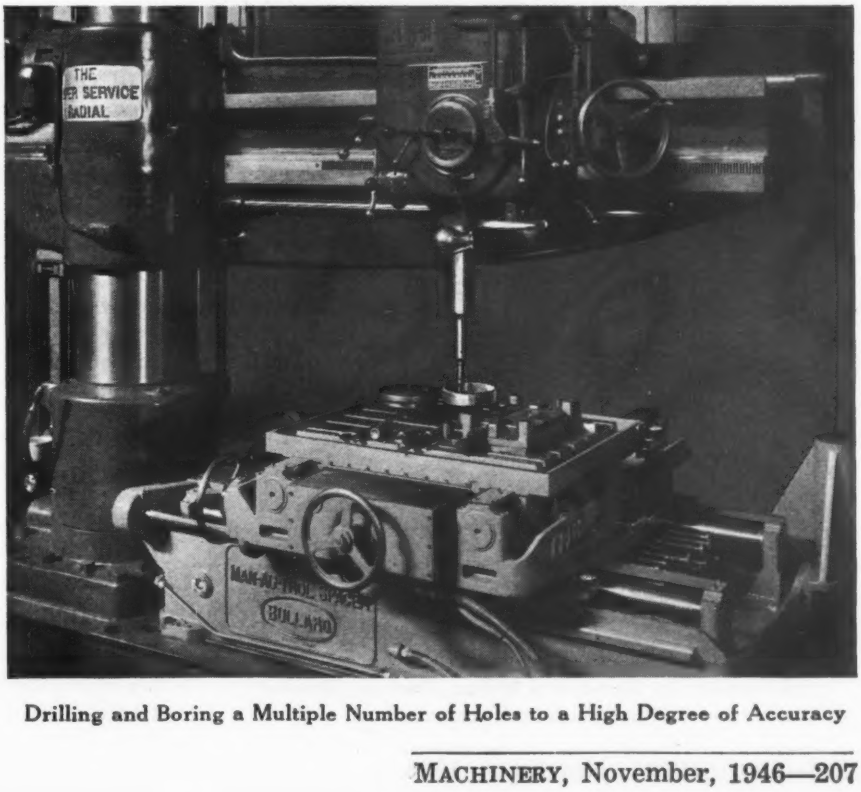
3. Good machinability, combined with high strength properties, is obtainable

4. Cast-iron dies are adaptable to heat-treatment and flame hardening.

Examples of many other applications, including high-temperature corrosion- and wear-resistant service conditions, could be cited, but the examples given reveal the varied characteristics of the modern new irons which are available to the production engineer, in his search for more serviceable materials with increased economy of finished production.

Precision Drilling and Boring with Bullard Man-Au-Trol Spacer

A set-up for small-lot production which facilitates accurate work and eliminates jigs and fixtures is shown in the accompanying illustration. Here a 30- by 20-inch Bullard Man-Au-Trol spacer is being used in performing drilling operations on three different parts on a Cincinnati Bickford radial drill. A number of holes located within an accuracy of plus or minus 0.0005 inch are drilled and counterbored in this operation. With the arrangement shown, it is possible to produce twelve pieces per hour. The Motch & Merryweather Machinery Co. recently sponsored this demonstration of the Man-Au-Trol spacer at the Cincinnati Bickford Tool Co.'s plant in Cincinnati.



Drilling and Boring a Multiple Number of Holes to a High Degree of Accuracy

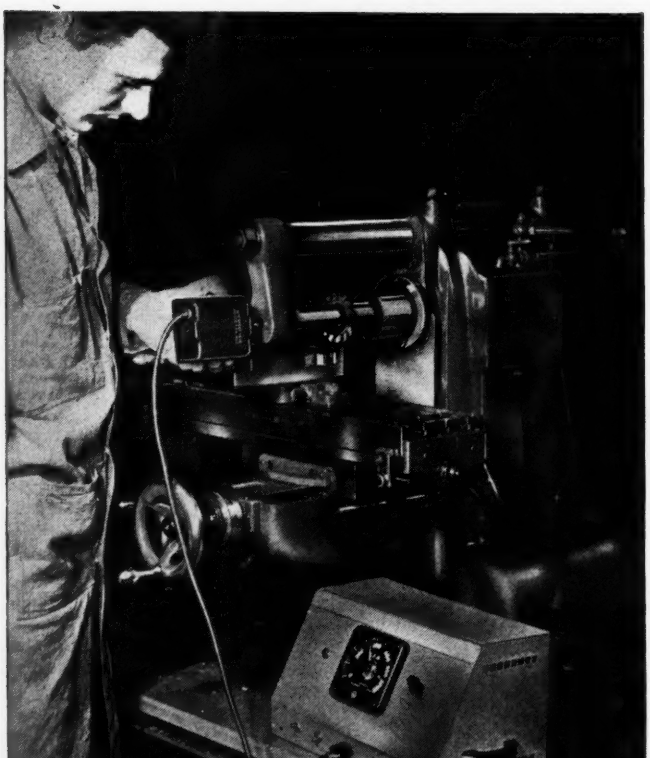
Engineering News

Electronic Tachometer Checks Speeds Accurately over Wide Range

Many tachometers are limited in range by the comparatively narrow limits of their scales, but this is not the case with a new electronic instrument developed by the General Electric Co. This tachometer, which weighs but 19 pounds, was designed to measure accurately the speeds of such diverse equipment as electric motors, machine tools, automotive and aircraft engines, pumps, fans, blowers, and other machinery operating within the limits of from 300 to 50,000 R.P.M.

The tachometer consists of a small pick-up head, a measuring unit reading directly in R.P.M., and 6 feet of connecting cable. Flexibility of application is supplied by the heads, of which there are two models—a low-speed unit that provides ranges of 0–1000, 0–2000, 0–5000, 0–20,000 R.P.M., and a high-speed model with ranges of 0–10,000, 0–20,000, and 0–50,000 R.P.M.

Each pick-up head contains a light-interrupting disk and a photo-tube. Light shining upon the photo-tube through the openings in the disk produces signals that are transferred to the measuring unit, which indicates the speed of the equipment being tested. Since the shaft to which the disk is attached rotates on ball bearings, and therefore requires very little torque, the speed of the equipment under test is not reduced by the use of the tachometer.



Measuring the Speed of a Milling Machine Mandrel with Electronic Tachometer

Device for Checking Composition of Ferro-Magnetic Materials

An instrument that is based on the correlation between magnetic properties, particularly remanent magnetism, which predominates at the low frequency used, and metallurgical properties, makes possible the determination of the composition and condition of ferro-magnetic materials by magnetic testing. A cathode-ray tube is employed as an instantaneous indicator. This device, which is known as the "Ferrograph," is a recent development of the Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

One practical application that has been made of the "Ferrograph" is the sorting out of steel bolts that were accidentally made from two different steels. The error was not discovered until after the bolts had been heat-treated. Bolts made of S A E 1035 steel were satisfactory, but those made from low-carbon S A E 1020 steel were too soft. There was a difference of hardness in the two lots of fifteen points on the Rockwell C scale. A few bolts made from each steel were identified on a hardness testing instrument, and their respective patterns were then established on the cathode ray tube screen. In this way, it was determined that there was no overlapping of the indications for bolts made from the two steels at the flux density chosen. Sorting of the mixed bolts was then carried out at the rate of about one bolt every second.

Cleaning Aluminum Preparatory to Welding by Inert-Arc Process

In searching for a satisfactory method of cleaning aluminum in preparation for welding by the inert-arc process, General Electric engineers recently found that when the work was first dipped in sodium hydroxide and sulphuric acid, mirror-bright fine-contoured beads could be produced. The practice is to immerse the parts to be welded for

a brief period in a 5 per cent solution of sodium hydroxide to remove all grease, oil, or wax, and then wash the parts in water to clean them of the caustic and scum. The aluminum is next dipped in a 50 per cent sulphuric acid bath. This completes the removal of the oxide skin and restores most of the surface brightness. A hot water bath is employed to remove the acid and leave the aluminum clean and dry.

Heavy Parachute Loads Decelerated by "Sand Bullets"

The use of "sand bullets" and an explosive charge causes heavy equipment dropped by parachute to be brought to a complete stop just before hitting the ground, according to a recent announcement of the Army Air Forces. This branch of our armed services conducted a study for such a deceleration process, with the object of eliminating damage to heavy para-crates, jeeps, and ordnance equipment dropped by parachute in the support of airborne forces.

Prelubrication Saves Lubricating for a Five-Year Period

Motor lubrication problems have been greatly simplified by the introduction of prelubricated bearings. In the motor manufacturer's plant, these bearings are sealed in a cartridge, along with the proper amount of the correct type of lubricant. Inspection periods were first set at three years. They have now been lengthened to five.

According to E. N. Fabrizio, of the Westinghouse Electric Corporation, thousands of motors with these prelubricated bearings have been installed since 1939, and have operated continually twenty-four hours a day at higher humidity and room temperature than are usually encountered in industrial applications. Inspection of motors chosen at random among approximately 600 installed in six different manufacturing establishments, where all of the motors had operated at least four years, twenty-four hours a day, disclosed that none of the motors with presealed bearings had been greased or lubricated in that time; nor did the lubricant have to be renewed even then. The motors were put back into operation about three years ago with the original lubricant. What the ultimate life is likely to be has not yet been determined, since the bearings are still running. At the present writing, there is reason to believe that the inspection intervals may be even longer than five years.

The chief advantages of prelubricated bearings, aside from the reduction in maintenance costs are as follows: The tightly sealed enclosure reduces oxidation of the lubricant and promotes longer life; (2) the grease is kept in the bearings and dirt and contamination is kept out; (3) the proper kind and amount of lubricant, once being provided, longer bearing life is promoted; and (4) when the motors are disassembled, the bearings are still enclosed in the cartridge, which protects them from dirt.

Mercury-Column Gage Inspects Piston-Rings Quickly and Accurately

Highly accurate measurements can be rapidly taken on piston-rings by means of an unusual gage recently developed by the Gulf Research & Development Co. in cooperation with the aviation industry. This instrument consists essentially of eighteen Solex gages or air fingers, which are spaced equidistantly around the circumference of the piston while it is held in the gage housing, as shown in the illustration. The pressure applied on the air fingers is recorded on the mercury columns. Only fifteen seconds is required for the inspection of a piston-ring.

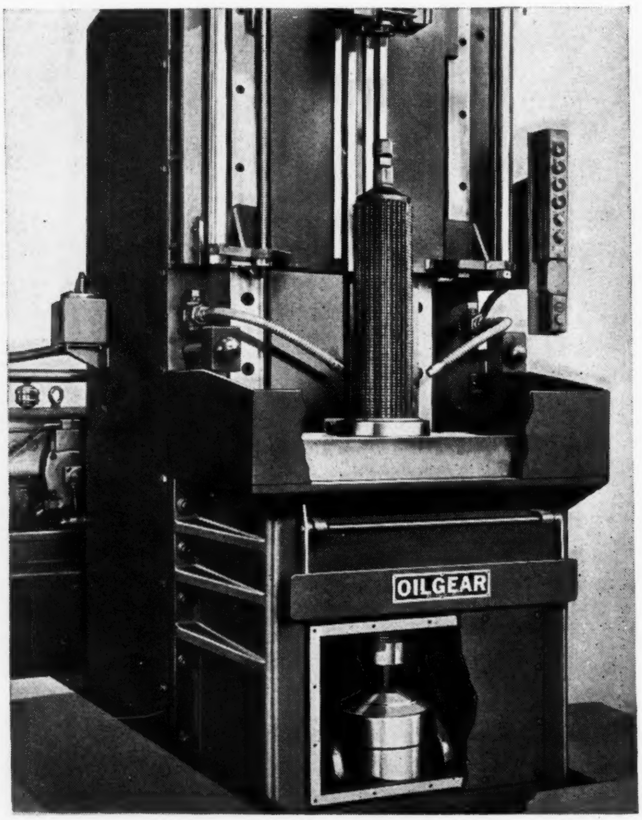
The instrument can be set to accommodate piston-rings from 2 1/2 to 6 1/8 inches in diameter. It is applicable for use in the automobile industry, as well as in the field for which it was originally designed. Gages for special applications can also be made by the concern.

Checking Piston-rings by the Use of a Multiple Mercury-column Gage

Broaching Thirty-Three Internal Involute Splines in One Operation

THIRTY-THREE involute splines are finish-broached in 8 1/2-inch diameter steel clutch driving-ring plates in a single pass on the 30- by 54-inch stroke vertical pull-down broaching machine shown in the accompanying illustration. This machine was designed and built by the Oilgear Co., Milwaukee 4, Wis., and the broaching tool was made by the Continental Tool Works Division, Ex-Cell-O Corporation, Detroit, Mich.

In operation, a clutch plate is placed on the machine table and the dual safety push-buttons are depressed to start the broaching cycle. As the upper tool-handling carriage descends, the tool shank accurately centralizes the clutch plate and enters the automatic puller on the main pulling slide. The main slide pulls the tool downward to broach the clutch plate. Both ends of the tool are securely held during the major portion of the broaching stroke. At the end of the broaching operation, the operator removes the broached plate and depresses the push-buttons, causing the main slide and tool to rise rapidly. The main slide stops automatically at a pre-set point, while the tool enters the upper holder and continues its upward travel to the starting position. The operator merely loads and unloads the clutch plates, the 370-pound tool being handled automatically by the machine. Approximately 0.530 inch of stock is removed on the inside diameter at a production rate of 120 plates per hour.



Vertical Pull-down Broaching Machine Equipped for Broaching Internal Splines in Clutch Plates

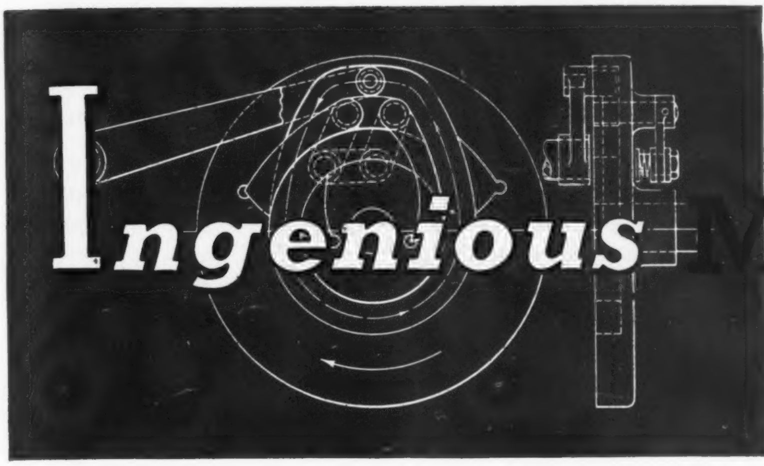
This machine is also equipped with a small slab type tool mounted on the main slide for finish-broaching the external mounting surfaces on 200 lever brackets per hour. A finger-tip switch is used for selecting manual or semi-cycle operation for internal broaching or semi-automatic operation for surface broaching. An Oilgear two-way variable-delivery pump transmits fluid power to the tool-pulling slide The cutting speed is variable up to 30 feet per minute, and the return speed is independently variable up to 80 feet per minute. A regenerative, stabilizing oil circuit to the main slide provides high return speed at comparatively low power consumption.

The table top is removable and the wide tool-pulling slide and removable puller bracket are adjustable to accommodate tools of different lengths. Automatic pressure lubrication provides a fresh film of oil on hardened and ground ways and other vital points at each semi-cycle of the machine. All tool-handling carriage and tool-pulling slide movements are interlocked and synchronized. Both stroke and position of the tool-slide can be adjusted to suit the broaching operation. Chips from the broach fall away quickly from the tool and cutting zone into a trough in the machine base.

* * *

National Materials-Handling Exposition

The first exposition to deal entirely with industry's materials-handling problems will be held at the Public Auditorium, Cleveland, Ohio, January 14 through 17. The exposition will provide an opportunity for executives to see modern methods of speeding materials along production lines and through plants. Such equipment as conveyors, hoists, cranes, trucks, tractors, and trailers will be shown. A four-day program of papers and discussions will be held concurrently with the exposition, prepared by materials-handling specialists in the aviation, automotive, chemical, electrical, and many other fields. Edwin J. Heimer, president of Barrett-Cravens Co., Chicago, Ill., is chairman of the exposition committee.



Ingenious Mechanisms

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and other Devices

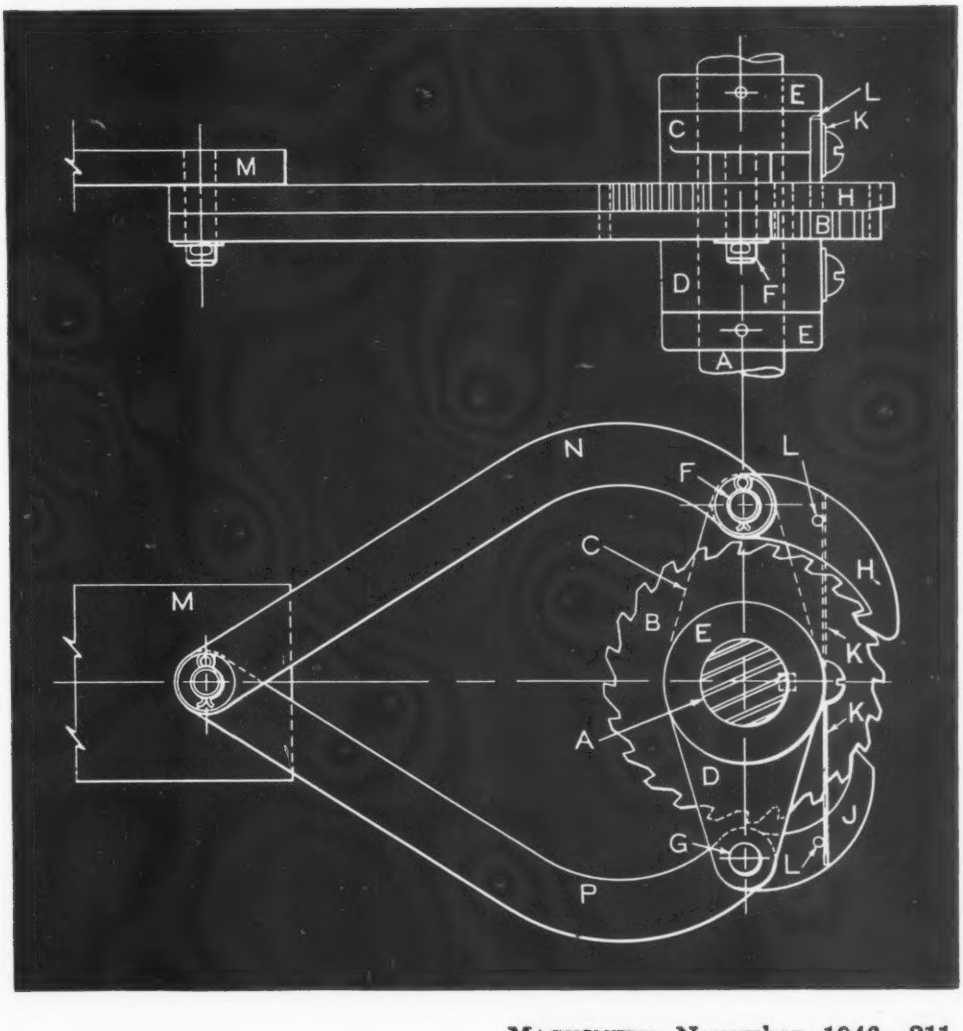
Ratchet Mechanism that Converts Reciprocating Movement to Continuous Rotary Motion

By H. B. SCHELL

In designing a certain mechanism, the problem arose of providing a rotary drive for a shaft when the only available motion was reciprocation in a plane at right angles to the axis of the shaft. It was required that the rotation be continuous in one direction, but it did not need to be absolutely uniform. The problem was solved by the ratchet mechanism here shown.

In the illustration, the shaft to be rotated is shown at *A*. It is supported in suitable bearings (not shown). Ratchet *B* is keyed to the shaft *A*. On each side of the ratchet and turning freely on the shaft are pawl arms *C* and *D*. These arms are held in place by collars *E* which are pinned to shaft *A*. At the outer end of arms *C* and *D* are pins *F* and *G*, about which pawls *H* and *J* are free to swivel. These pawls are held in contact with the teeth of ratchet *B* by springs *K*. The latter are attached to the hubs of the pawl arms and bear against spring pins *L* mounted on pawls *H* and *J*.

The reciprocating member *M* is connected by links *N* and *P* to the outer ends of the pawl arm pins *F* and *G*. One link is above ratchet *B*, and the other link below the ratchet.



Ratchet Mechanism which Provides a Continuous Rotary Movement that is Derived from a Reciprocating Motion

As reciprocating member *M* moves toward the right, the ratchet is rotated counter-clockwise by the pawl *J* engaging a ratchet tooth. During this movement, pawl *H* rides over the ratchet teeth. When member *M* moves to the left, pawl *H* engages a ratchet tooth and continues the rotation of both the ratchet and shaft *A* in a counter-clockwise direction. During this movement, pawl *J* slips over the ratchet teeth.

The pawls are beveled at their outer ends on the side adjacent to each other, as shown by pawl *H* in the plan view, so that the two pawls can pass each other without interference when they are at the extreme right-hand end of their travel. Likewise, links *N* and *P* are curved, so that they will readily clear ratchet *B* when member *M* is at the extreme right-hand end of its movement. A flywheel (not shown) promotes uniformity of motion of the driven shaft.

Fine Feeding Mechanism Adjustable from 1 to 50 Microns per Revolution

By BERNARD J. WOLFE, Special Development Engineer
Eastman Kodak Co., Rochester, N. Y.

The fine feed of carriage *U*, Fig. 1, adjustable in increments of 1 micron from 1 to 50 microns per revolution of drive-shaft *C*, was obtained by means of the mechanism illustrated in Figs. 1 to 5. This design eliminates the reciprocating parts commonly encountered in feeding devices, which might cause vibration and chatter. The index-wheel *Q*, Fig. 2, can be turned in either direction while the machine is in operation, thus increasing or decreasing the feed within the range for which the mechanism is designed. The feeding range can be increased to any number in excess of 50 microns by increasing the diameter of the ratchet and cams to obtain the desired change in feed.

An advantage of this mechanism is that the fine feeds are obtained with standard tolerances and parts. Commercial gears with some backlash are satisfactory. The ratchet wheel *M* has a relatively coarse pitch of 3/32 inch, with a correspondingly long life for the tooth of pawl *H*. The feed-screw *T* is 1/2 inch diameter with a 2 millimeter pitch thread, which is relatively coarse for such a fine feed. The only point where extreme care must be exercised is between the feed-screw and the carriage nut, it being necessary to prevent any backlash.

Another advantage of this mechanism is that it is comparatively silent in operation. In conventional reciprocating type of feeding mechanisms, the pawl, on the return stroke, usually rides over the ratchet teeth and makes an annoying clicking noise. It also tends to wear both the pawl and ratchet teeth, which is eliminated in the mechanism described.

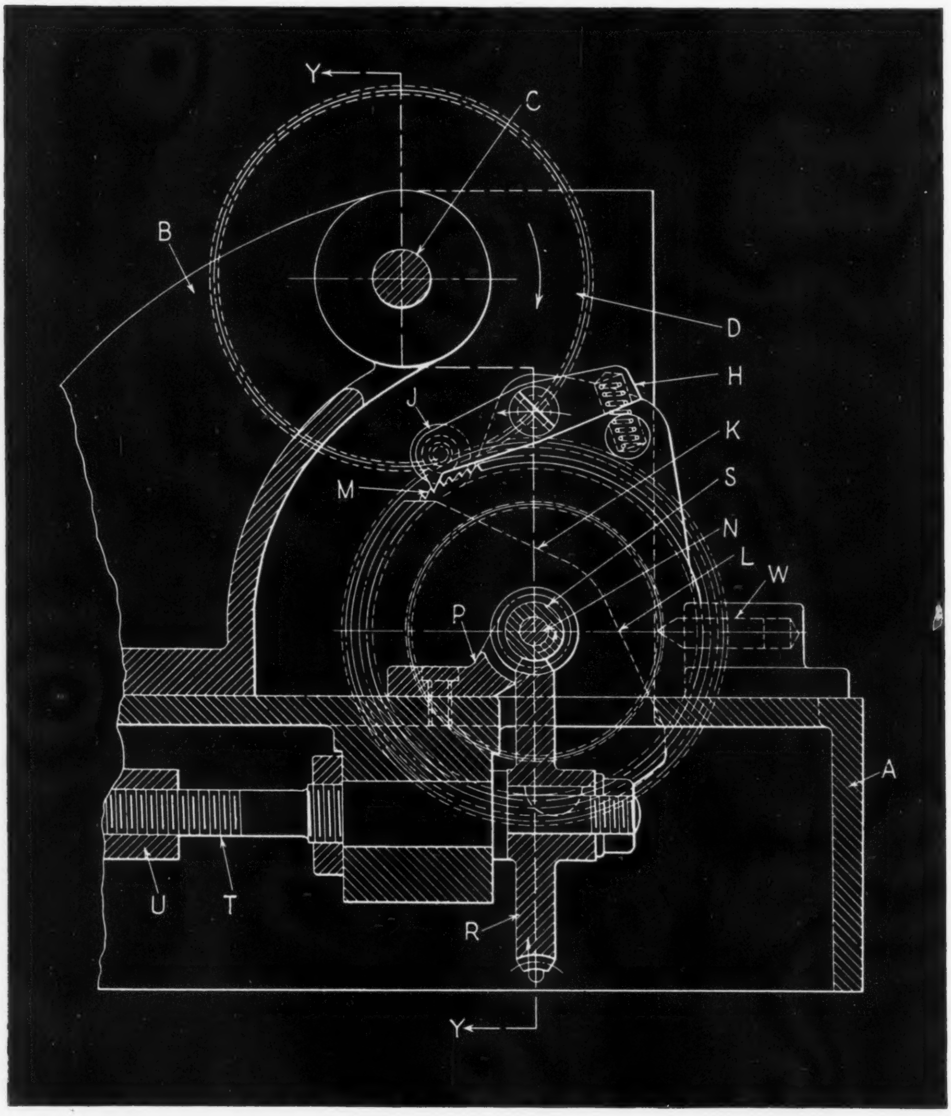


Fig 1. End View of Feeding Mechanism Taken through Section X-X of Fig. 2, Showing Carriage U which Moves on Feed-screw T the Desired Number of Microns per Revolution of Driving Shaft C

The feeding mechanism consists essentially of a base *A*, on which is mounted an upright casting *B* that supports drive-shaft *C*, as shown in Figs. 1 and 2. Gear *D*, which is fastened to one end of this shaft, drives gear *E*. The latter gear, which is secured to pawl-carrier *F*, is mounted on sleeve bearing *G*. Pawl *H* carries a roller *J* on its driving end, and is held to carrier *F* by a stud on which the pawl pivots. As the pawl-carrier is rotated by driven gear *E*, the pawl is carried above the ratchet wheel *M* for a portion of each revolution when roller *J* rides on cams *K* and *L*. When roller *J* is carried past the cam surfaces, the pawl engages the ratchet wheel through spring action and drives it.

Ratchet wheel *M* is pinned to shaft *N*, which is mounted on bearings *P*. Worm *S*, which engages worm-wheel *R*, is also pinned to this shaft. The worm-wheel is keyed to the feed-screw *T*. The 30 to 1 ratio of the worm to the worm-wheel is such that an advance of one tooth of the ratchet wheel rotates the feed-screw 1 micron. The feed-screw moves carriage *U* back and forth on ways (not shown in the drawings).

The relative position of cams *K* and *L* shown in Fig. 1 occurs when the index-wheel is set at 50. This setting and cam position cause the pawl to be lifted out of engagement with the ratchet wheel for half of the cycle—180 degrees—of the pawl-carrier. During the remaining half of the cycle, the pawl engages the teeth on the ratchet wheel, and through the worm and worm-wheel, imparts the maximum feed to the feed-screw of 50 microns per revolution of the drive-shaft. To reduce this rate of feed, the index-wheel is turned to any intermediate position between 0 and 50, which changes the position of cam *K*. The non-adjustable cam *L* is fixed to sleeve bearing *G*, which is held in bracket *O*.

Index-wheel *Q* is mounted on shaft V_1, which turns in sleeve bearing *G*. Cam *K* is mounted on the other end of this shaft, and is turned an amount corresponding to the change in setting of the index-wheel. This varies the angular opening between the cams, permitting the pawl to engage more or fewer teeth on the ratchet wheel, depending upon the setting. When the index-wheel is set at 25,

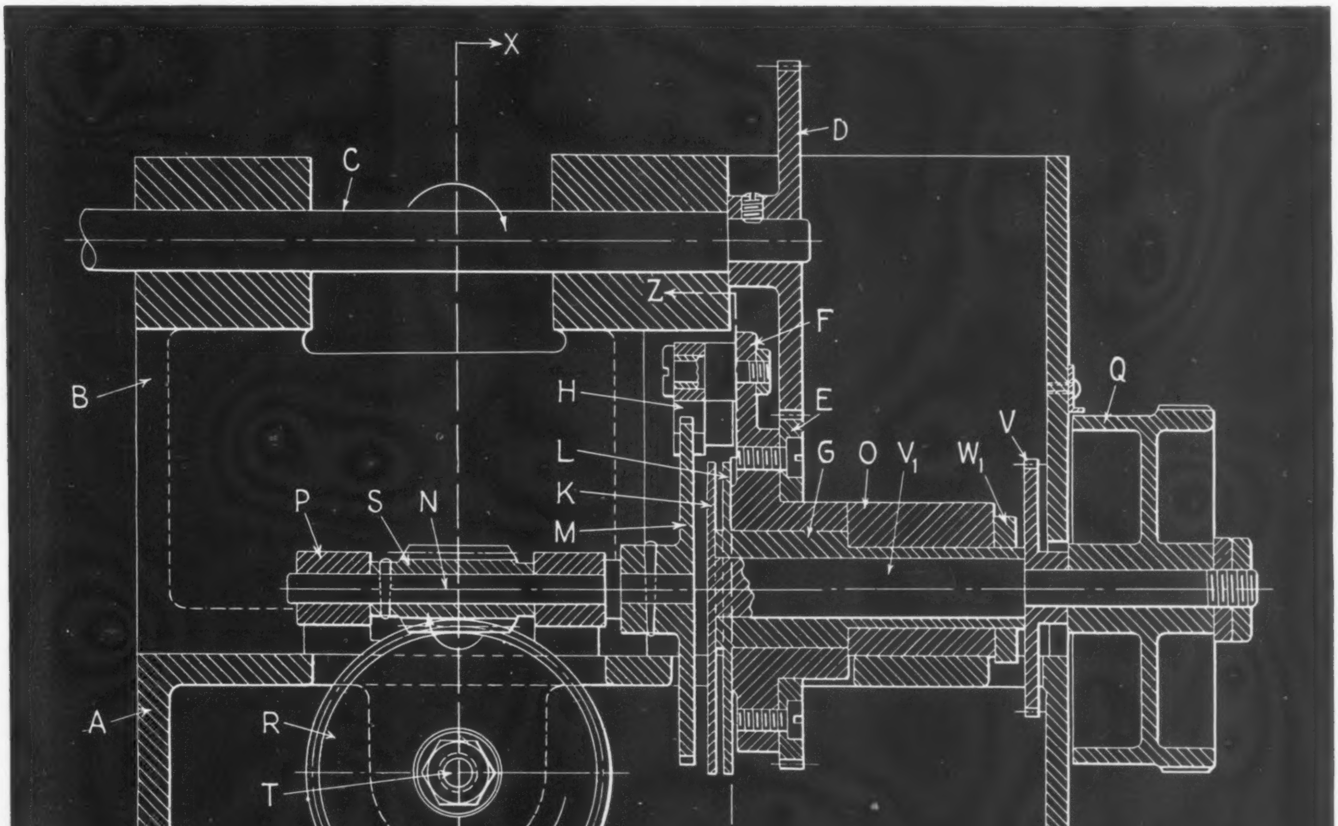


Fig. 2. Section Y-Y of Fig. 1, Showing how the Feed-screw T is Turned by Worm-wheel R, Worm S, Shaft N, Ratchet Wheel M, Pawl H, Pawl-carrier F, Driven Gear E, Drive-gear D, and Drive-shaft C

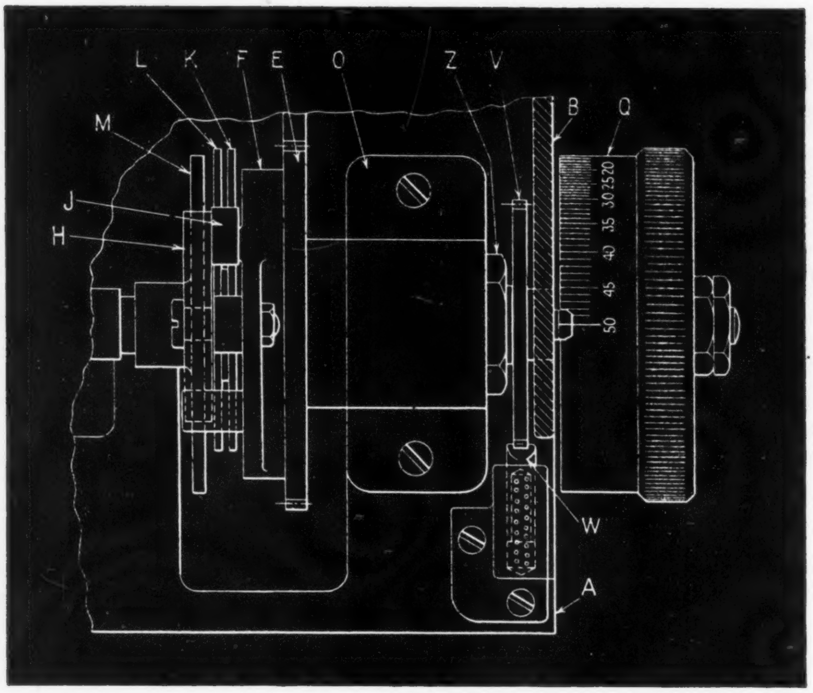


Fig. 3. Partial Plan View of Feeding Mechanism, Illustrating how the Setting on Index-wheel Q is Held by the Detent of Spring Plunger W Entering between the Teeth of Gear V

cam K is moved to the position shown in Fig. 4. Fig. 5 shows the relative position of the cams when the feed has been further reduced to 12 microns per revolution of the driving shaft.

A gear V, Fig. 2, having the same number of teeth as ratchet wheel M, is also mounted on shaft V_1. This gear is frictionally held to any setting on the index-wheel Q by means of a detent on spring plunger W, Fig. 3, which enters between the teeth of gear V. The number of teeth in this gear also corresponds to the number of graduations on index-wheel Q. The index-wheel is revolved, by gripping the knurled rim, to any number and held there by the detent.

The feeding cycle can be adjusted to begin at any predetermined point with respect to the drive-shaft C, Figs. 1 and 2, by changing the angular position of cam L. This is accomplished by loosening nut W_1, and revolving the sleeve bearing G and cam L, which is fixed to this bearing, to the desired position. The cam is then locked in this position by again tightening the nut.

* * *

Those who are advocating basing wages upon ability to pay, and an industry-wide wage scale, represent a small minority of the people of the United States. They are, in effect, asking for special privilege at the expense of other workers, the farmers, the professions, and the rest of the general public. If the American form of government is to continue, wages as well as prices must be competitive.—*George T. Trundle, Jr.*

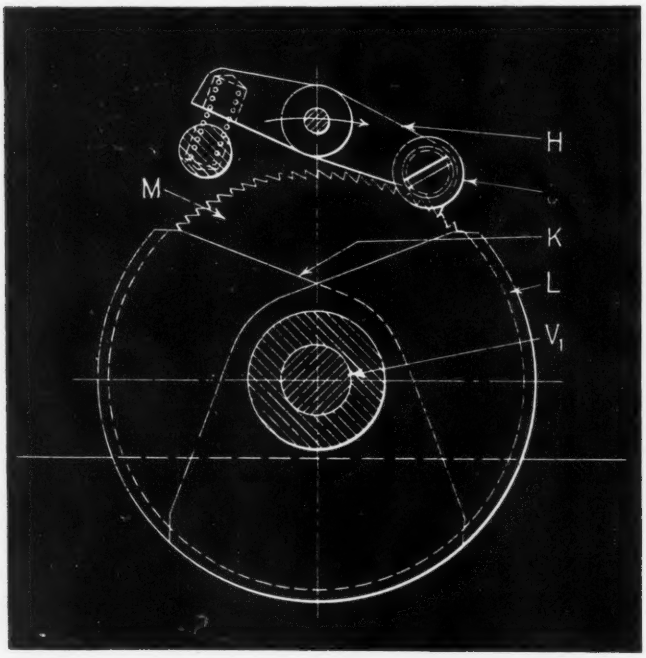


Fig. 4. Section Z-Z, Fig. 2, Showing the Relative Positions of Cams K and L for a 25-micron Feed per Revolution of the Drive-shaft. Here Pawl H is Shown in Engagement with Ratchet Wheel M

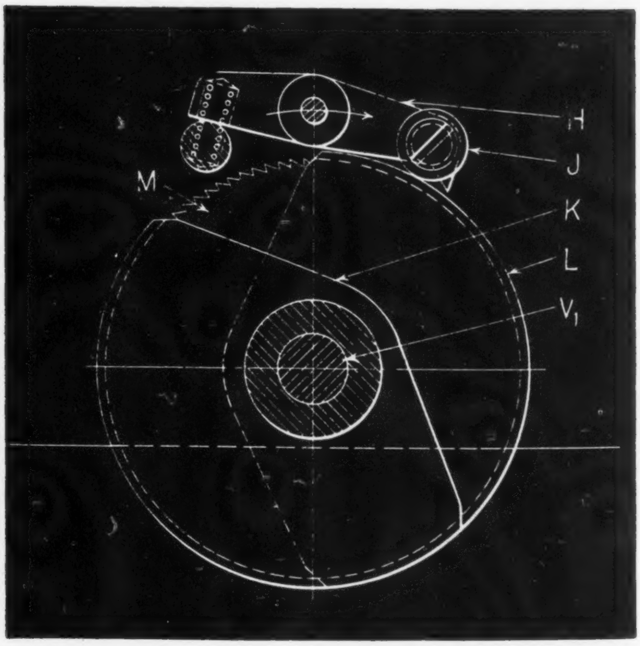
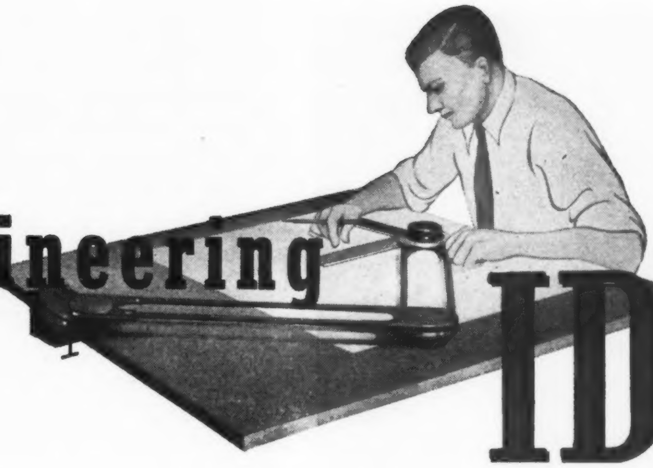


Fig. 5. Another View on Section Z-Z, Fig. 2, Showing Relative Positions of Cams K and L for a 12-micron Setting. In This View, Pawl H is Shown Disengaged as Roller J Rides on Cams K and L

Tool Engineering IDEAS



Automatic Work-Indexing Device for Milling Machine

By EDWARD LAY, Ozone Park, Long Island

Slotting commutators for small electric motors is usually a slow, tedious operation when indexing is done manually, and often results in rejections. The automatic indexing device illustrated was used by one plant to eliminate these troubles, and it increased the output of work by 75 per cent. The device was applied to a hand-operated, bench type milling machine, and permitted an operating speed of 70 strokes per minute.

After loading the work, the operator moves the

Automatic Work-indexing Device Designed for Application on a Bench Type Milling Machine

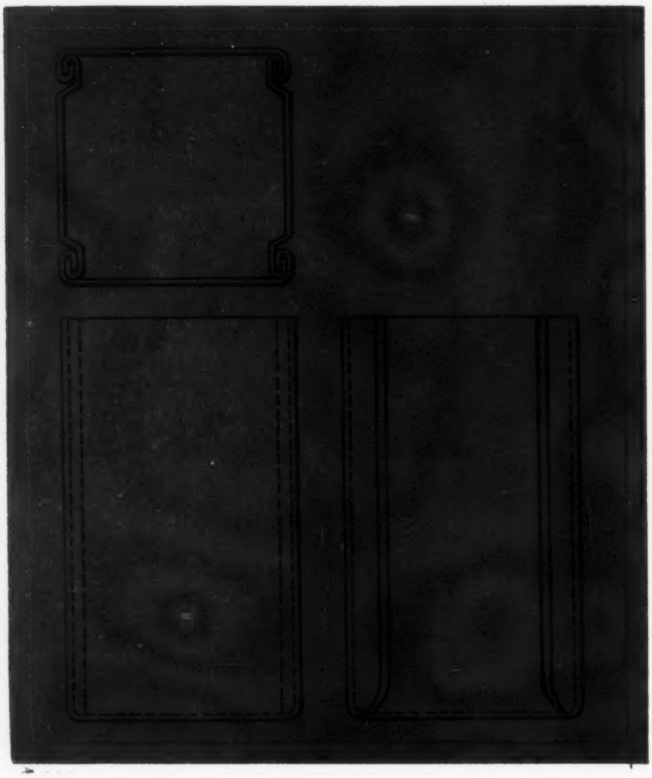


Fig. 1. Air-tight Steel Container that is Drawn and Formed in One Operation by Means of the Punch and Die Shown in Fig. 3

machine table toward the saw and completes the first slot. A stop is used to limit the table travel to the required amount. The table is then reversed and the work is automatically indexed by means of the mechanism illustrated.

Near the end of the table movement, bellcrank *O* comes in contact with the adjustable stop-pin *R*, which is fastened to the end of the milling machine frame. The movement of the table, however, is continued in this direction until a second table-stop is reached. The movement of the bellcrank pulls downward yokes *Q*, rod *S*, and the end of the rocker arm *E* connected to the yoke. The opposite end of the rocker arm, to which is fastened pawl *F*, moves up, turning ratchet wheel *D* one division. As fourteen slots are to be cut in the commutator, the ratchet wheel is made with fourteen divisions of approximately 25 degrees 42 minutes each.

Bracket *A* is bolted in position on the milling machine table to support shaft *B*, which is a close fit in the bore of the bracket. This shaft supports a work-clamping screw, the work-piece, locking wheel *C*, ratchet wheel *D*, and rocker arm *E*. In addition to the index pawl *F*, a flat spring *T* is attached to the rocker arm. This flat spring keeps the index pawl in contact with the ratchet wheel.

Stud *K* holds locking pawl *G* and spring *H* in place. Spring *H*, which holds the locking pawl against the locking wheel *C*, is fastened to the stud by screw *J*. Bellcrank *O* is secured to the cross-brace *P*, which, in turn, is attached to the bracket *A*. Locating pin *L*, to which spring *M* is hooked, is also attached to the cross-brace. Spring *M* returns the rocker arm *E* to its original position after indexing has been completed. Set-screw *N* stops the bellcrank in the correct position for the next indexing.

Die for Making Square-Cornered, Air-Tight Containers in One Operation

By C. W. HINMAN, Designing Engineer

The air-tight container shown in Fig. 1 is drawn and formed from a 1/64-inch thick, soft, deep-drawing steel blank in a single operation. Thousands of these containers, both square and rectangular in cross-section, have been produced in a mid-western plant. The corner seams are ironed so smooth that they are not easily detected. The depth of container to be formed is limited only by the length of the press stroke.

Fig. 2. Blank of 1/64-inch Thick SAE 1010 Sheet Steel Used in Drawing and Forming the Container Shown in Fig. 1

Fig. 3. Punch and Die Used in Drawing and Forming the Blank Shown in Fig. 2 to the Shape of the Container Shown in Fig. 1 in One Operation

The blank from which the work is drawn is shown in Fig. 2. Two opposite arms of the blank have their edges formed to 45-degree wings during the blanking operation in a semi-compound die. The over-all width A across the wing-formed arms is the same as the width of the flat arms of the blank. Widths A are also wide enough to form the hooked seams. The blank is drawn to a depth of approximately 1/4 inch at the start of the operation, as is indicated by the outline of the finished container shown in broken lines, symmetrically positioned on the blank. The corners D are drawn higher than the formed sides of the container. The size and angles of the clipped corners of the blank were determined by experiment. They permit the forming of an even edge around the mouth of the containers, and trimming is unnecessary.

The punch and die used for this combination drawing and forming operation are seen in Fig. 3. The die is a round block of steel with a square opening through the center, the same size as the outside of the container. The mouth of the die is provided with drawing radii R, which are tangent to the top surface and the sides of the opening in the die. Two of these radii, on opposite sides of the die opening, which form the winged arms of the blank, are made smaller than the radii on the other two opposite sides, which form the flat arms of the blank. The punch is made with recesses B at its four corners, in which the seams are formed, hooked together, and ironed.

The blank is first symmetrically positioned over the die opening in a "nest," with the wings of the two formed arms turned up toward the punch. When the descending punch comes in contact with the blank, the winged arms rise and enter the die before the two flat arms because their respective drawing radii in the die are smaller.

This prior entry of the winged arms into the die starts the curl of the corners of the drawn part in the desired direction, as shown by section X-X, Fig. 3. After completion of the 1/4-inch draw, the two flat arms enter the die. This action and the twisting moment transmitted by the curl of the drawn section force the adjoining arms to form a seam, as shown by section Y-Y. The extra rise of metal at the corners of the drawn section hooks these seams together. As the punch continues to descend, it irons the seams flat and smooth against the corner walls of the die opening, as shown by section Z-Z. The finished container is stripped from the punch as the punch ascends.

Adequate lubrication is required for this type of operation. A soluble mineral oil is used for drawing and forming thin-walled steel containers such as the one shown.

* * *

New Officers of the Magnesium Association

At the third annual meeting of the Magnesium Association, 30 Rockefeller Plaza, New York City, held at the Waldorf-Astoria Hotel in New York on October 3, the following officers were elected: President, R. D. Taylor, assistant manager, Eastern Operations, Federated Metals Division, American Smelting & Refining Co., New York; vice-president, J. D. Barrington, vice-president and general manager, Dominion Magnesium, Ltd., Toronto, Canada; and treasurer, Irving T. Bennett, vice-president, Revere Copper & Brass, Inc., Baltimore, Md.

* * *

Does social security mean freedom of everybody from all work?—*Harvey Campbell*

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Bright Corrosion-Resistant Surface for Zinc or Cadmium Plate

A mirror-bright transparent film on zinc- or cadmium-plated parts is produced by a new chemical process known as "Iridite Bright," developed by Rheem Research Products, Inc., 4004 E. Monument St., Baltimore 5, Md. This process forms a chromate coating on the zinc or cadmium surface that protects the part from marks produced by handling and prevents tarnishing. Application is by immersion in a water solution after the plating operation. 201

Kennametal Extruded Rounds Available for Wear-Resistant Parts

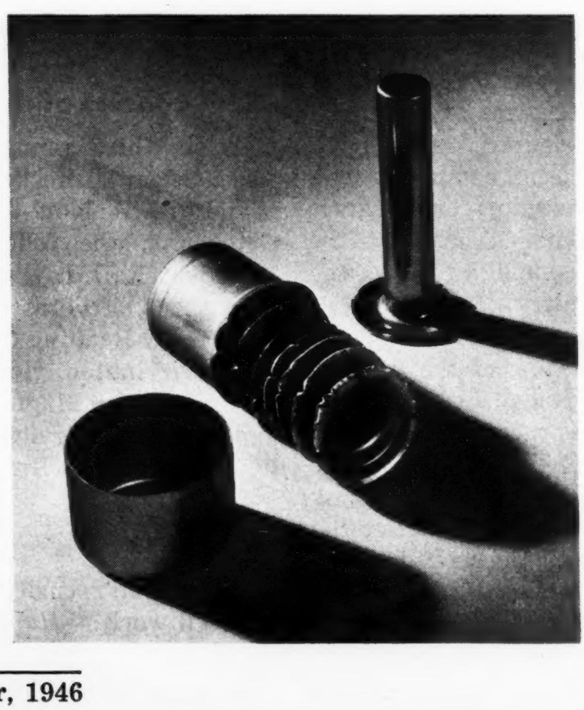
Kennametal Inc., Latrobe, Pa., is now manufacturing a line of solid Kennametal extruded rounds which are available in two straight tungsten-carbide grades—KE5 and KE7—with Rockwell A hardnesses of 89.0 and 91.0, respectively.

These rounds have been developed primarily for use as wear-resistant elements, and are suitable for such applications as guides, feeding fingers for automatic machines, rollers, guide rails, laps, scribers, points for engraving tools, thread checking wires, etc. They are furnished in either rough extruded or centerless-ground form, in diameters ranging from 1/32 to 1/4 inch and in standard lengths from 1 to 10 inches. Kennametal can also be extruded in other forms, such as flats, tubes, triangles, squares, and ovals. 202

Improved Phenolic Resin Eliminates Air Bubbles in Plastic Castings

A water-like synthetic resin especially adapted for plastic casting has been developed by Duorite Plastic Industries, 8564 W. Washington Blvd., Culver City, Calif. This product is a modification of "Plastitool," a high-strength phenolic used for aircraft tooling during the war. Its outstanding characteristic is the elimination of air bubbles, which have heretofore made the production of complex plastic castings extremely difficult and sometimes impossible.

The new "Plastitool" resin does not retain air bubbles after casting because its water-like viscosity enables the forces of gravity to draw the



Rough Shells Representing Nine Stages in Drawing Allegheny Metal Type 304 Stainless-steel Pen Cap without Annealing. Total Reduction from Blank Diameter is 80.5 Per Cent. Final Draw Produces Thin-walled Shell 0.488 Inch in Diameter and 2.4375 Inches High. This Part is Manufactured by the Eisen Metal Products Co.

liquid resin down into a homogeneous mass within the mold. It is hardened or cured by means of a catalyst and heat, much the same as other phenolic resins. Tests have shown that the castings produced have essentially the same strength as the older form of "Plastitool." 203

Solder with Flux in Grooves on Outside Surface

A wire solder known as "Fluxrite," manufactured by the National Lead Co., 111 Broadway, New York 6, N. Y., is designed to deposit flux on the work before the solder. This is accomplished by providing flux in four closed grooves on the outside surface of the solder, assuring a rapid, even flow of flux on the surface of the work. 204

High-Speed Steam Cleaning Detergent for Heavy-Duty Industrial Use

A heavy-duty, alkaline type detergent especially designed for use in modern steam guns and coil type steam-generating mechanisms has been announced recently by Oakite Products, Inc., 26 Thames St., New York 6, N. Y. The new high-speed detergent, called "Oakite Composition No. 92," has been pre-tested during the past year. Considerable reductions in time and expense for such jobs as the following have been recorded: Cleaning machinery and equipment parts for subsequent repair and overhaul; preparing equipment surfaces for repainting or refinishing; cleaning equipment too large for tank immersion or where suitable tanks are not available; paint stripping and other cleaning operations.

The new Oakite detergent gives thorough and fast steam-cleaning action at very low concentrations, and has the advantages of preventing scale clogs in steam coils; ready dissolution in hot water; free-rinsing action on all surfaces; and safe handling without offensive fumes or toxic vapors..205

Dye Solution Applicable to Many Types of Plastics

A dye solution known as "Kriegr-O-Dip" is a new product of the Krieger Color & Chemical Co., 6531 Santa Monica Blvd., Hollywood 38, Calif. This solution has been found suitable for coloring polystyrene, acetate, Lucite, Plexiglas, vinylite and nitrate plastics. The plastic to be colored is dipped in the solution for a period of from one to ten minutes, depending upon the shade required. After being removed, it is washed in water and is ready for use when dried. The dyes are available in a wide variety of colors. 206

Compound Protects Fluorescent Lamps from Humidity

Fluorescent lamps and miniature vacuum tubes can be protected from the detrimental effects of high humidity by a new water-repellent material called "Dri-Film." This film, developed by the General Electric Co., Schenectady, N. Y., is said to be the best material yet found to form a continuous insulating film over glass. Tests have shown that lamps coated with "Dri-Film," even when used with metal, such as a reflector, are practically insensitive to high humidity. The new compound was first employed for treating ceramic radio insulators used by the armed forces during the war period. 207

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on these pages, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in November, 1946, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on the blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

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Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Cincinnati New Series "Hydro-Tel" Milling Machine

Exceptional versatility is a feature of the new 16-inch vertical milling machine recently added to the "Hydro-Tel" line built by the Cincinnati Milling Machine Co., Cincinnati 9, Ohio. The basic machine furnished for general-purpose milling, as shown in Fig. 1, has a fixed-height bed cast integral with the rear base. The table is carried in wide-spaced, square-gibbed ways on top of the bed, and a heavily proportioned cross-slide unit is similarly mounted on top of the rear base. The vertical spindle-carrier unit is mounted in bearing ways on the front face of the cross-slide.

The rigidity of this type of structure, combined with the ease of operation obtained from hydraulic actuation and control, permits the three distinct styles in which this machine is built to cover an extremely wide range of work. The basic style machine is provided with hand and power feeds to the table and cross-slide. Hand feed only is furnished for vertical positioning of the spindle-carrier. This machine is especially adapted for the performance of hand-controlled die-sinking operations, as well as for general-purpose work.

When equipped for die-sinking, as shown in Fig. 2, the basic machine is furnished with automatic depth control and an automatic tracer mechanism which provides for sensitive, automatic duplication of templets or master shapes.

The profiling machine is equipped with an automatic hydraulic 360-degree profiling mechanism, and is supplied for tracer-controlled profiling work. Since contact pressure of the tracer finger is very light, master forms or shapes can be made of wood, plaster-of-paris, or any of the various pattern compounds. The sensitivity of the tracer is such that profiling or forming cuts can be made with either hand or power feed.

Hand and power feed movements of the sliding elements of these machines are hydraulically actuated. Handwheels can be operated by finger-tip pressure, regardless of the work size or cutting load. Power feed rates are non-related, and are independently controlled and selected. If necessary, they can be used simultaneously at different rates. Being infinitely variable, they permit selection of the exact feed rate desired.

Feed rates for both table and cross-slide range from 1 to 25 inches per minute. A special feed range of 1/2 inch to 12 1/2 inches per minute for die-sinking applications is available at extra cost. All operating controls are located at the front of the machine within easy reach of the operator.

Power feeds for table and cross-slide are actuated by a single-directional control lever having five operating positions for controlling both feed and rapid traverse in both directions. Table and cross-slide handwheels are carried on adjustable brackets which permit them to be swung below the level of the table when loading large parts. Vertical-feed handwheels duplicated at right- and left-hand sides of the spindle-carrier facilitate positioning of the spindle-carrier. All handwheels are equipped with micrometer dials for accurate positioning of the slides, and a built-in scale and pointer is supplied for both the table and the vertical spindle-carrier to simplify rough positioning. The handwheel

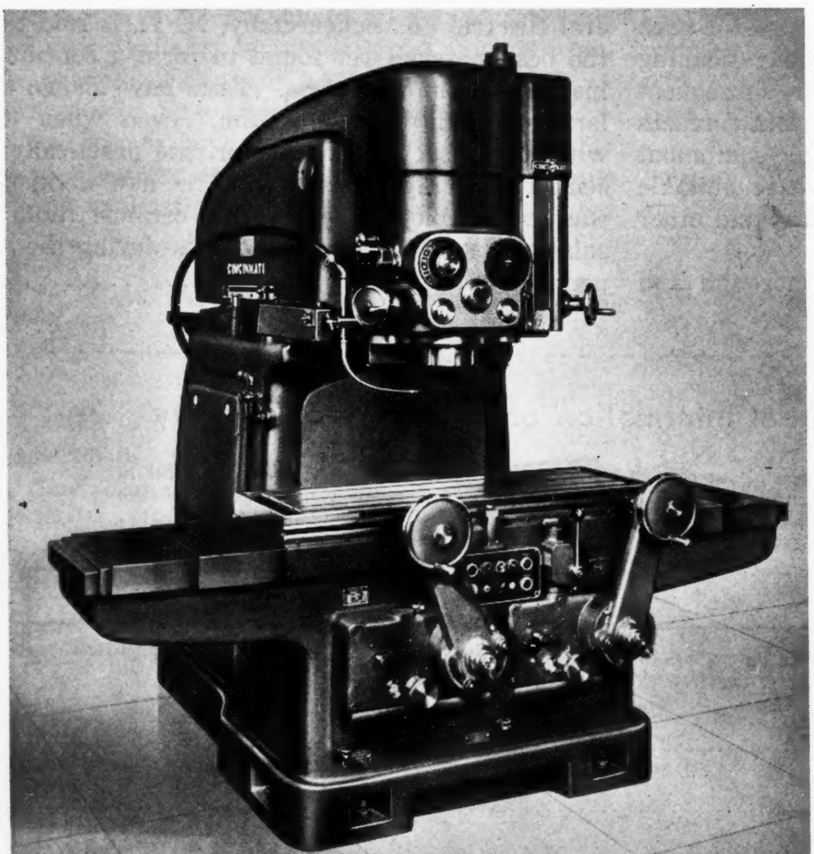


Fig. 1. Cincinnati Vertical "Hydro-Tel" Milling Machine

To obtain additional information on equipment described on this page, see lower part of page 248.

of either slide can be used in conjunction with the power feed of the other slide to permit following complex "lay-off" lines in performing die-sinking operations.

Power feed rates to the table and cross-slide are selected by a hand-knob with graduated dial, and can be changed while the machine is cutting. Spindle speed changes are made with a crank, and are indicated by the large dial on the face of the spindle-carrier. A large easily read calculator adjacent to the speed selector dial facilitates selection of the correct spindle speed under all cutting conditions. Sixteen spindle speeds are supplied, the standard range being 25 to 1500 R.P.M. with an optional range of 33 to 2000 R.P.M. A high-speed spindle attachment is available which gives 2.5 times the regular spindle speeds. This attachment has a No. 40 series taper hole and a quick-change type spindle nose. Power vertical speed to the spindle-carrier is available at extra cost, which provides feed rates ranging from 1/4 inch to 3 3/4 inches per minute. This feed is especially adapted for boring operations, the feeding rates being infinitely variable within its range. A rapid traverse of 20 inches per minute is provided for this drive.

An indicator light on the push-button control panel signals the need for cleaning when the stone filter for the hydraulic oil system becomes clogged. All important bearings are automatically lubricated with filtered oil, and another light on the control panel warns of low oil level in the lubricating oil reservoir.

All three styles of this machine are equipped with sheet-steel guards for the ways, which exclude chips and dirt from the table and cross-slide bearings. Built-in leveling jacks are provided to simplify accurate leveling of the machines. 51

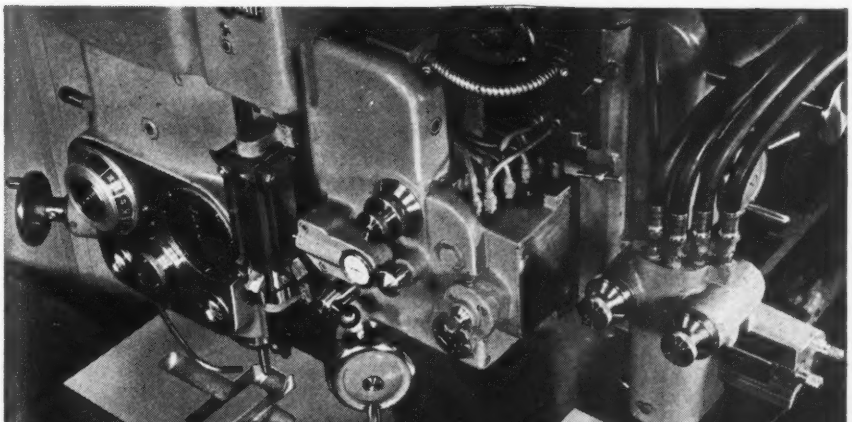
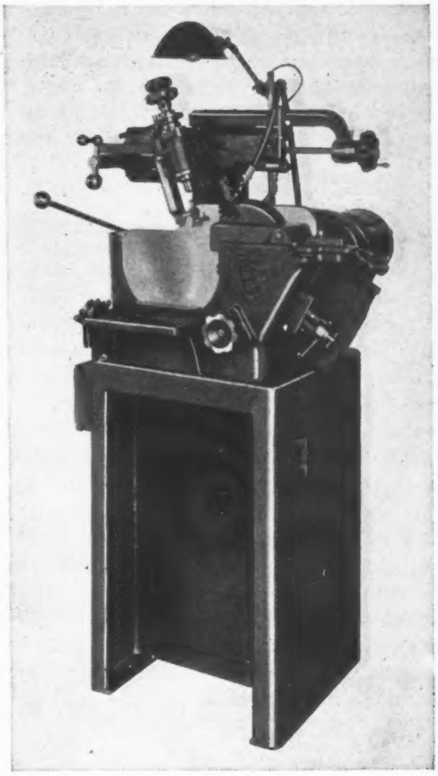


Fig. 2. "Hydro-Tel" Die-sinking Machine with Automatic Depth Control

Blake Flute Grinder

A grinder designed to provide the positive, mechanical controls required for accurate, rapid, and easy sharpening of both the spiral points and straight flutes of taps is a new development of the Edward Blake Co., 634 Commonwealth Ave., Newton Centre 59, Mass. Other straight- and angular-fluted tools, such as countersinks and drills, can also be sharpened on this machine.

Operation of the grinder is said to have been so simplified that an unskilled workman can learn quickly to produce an accurately ground spiral point. Loading, indexing, and feeding operations are performed with the hands at a safe distance from the grinding wheel. This and other features, such as the provision of ample working space for the operator outside the plane of the grinding wheel, insure maximum safety. The grinding dust is directed downward into the bottom of the coolant tank when dry grinding.



Flute Grinder Brought out by the Edward Blake Co.

The machine is completely self-contained, a removable coolant system being housed in the base. The motor-driven coolant pump is controlled by the same switch that controls the spindle motor. The standard machine will handle right- and left-hand taps from the smallest up to the 5/8-inch diameter size, and under certain conditions it will accommodate taps of much larger diameter. Regular equipment permits grinding two-, three-, and four-flute taps, and simple index plates can be furnished for grinding taps with a greater number of flutes.

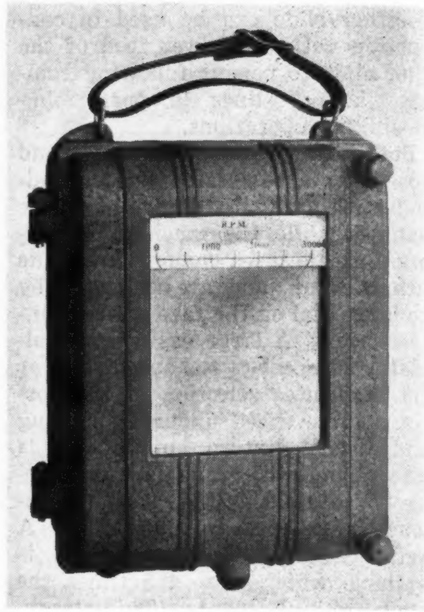
The diamond truing device is always centrally located with respect to the grinding wheel, and enables the thickness of the wheel, as well as the dressing of the radius, to be easily controlled. Movement of the diamond is controlled by a mechanism that permits dressing the wheel at any time, even during a grinding operation.

A unique method of holding the tap is employed to eliminate vibra-

To obtain additional information on equipment described on this page, see lower part of page 248.

tion when grinding a spiral point. The complete collet-holding work-head operates on a vertical counter-balanced slide, which can be easily moved up and down by means of an adjustable lever. Both rapid- and micrometer-feed crosswise movement of the work-head is provided. The spindle carrying the grinding wheel is adjusted on the cross-slide by a feed-screw which is equipped with a micrometer dial. 52

General Electric Tachometer Recorder



Tachometer Recorder Made by the General Electric Co.

A new light-weight inkless tachometer recorder designed to provide a record of rotating speed within a range of 0 to 3000 R.P.M., has been announced by the Meter and Instrument Division of the General Electric Co., Schenectady 5, N. Y. This recorder is intended to operate with an aircraft type alternating-current tachometer generator, although any alternating-current generator with suitable operating characteristics can be used.

When employed in conjunction with aircraft style tachometer generators, the speed range under normal conditions is 600 to 2500 R.P.M. The record is made on a 4-inch wide roll by means of a typewriter ribbon which eliminates blotting or flooding. The standard chart speed is 3 inches per hour, but additional gears are available for chart speeds of 1 inch per hour, 2 inches per hour, or 1 inch per day.

The cast-aluminum alloy enclosing case is splash- and weather-proof, and has a pressure gasket between the case and cover. Although furnished in portable form, it can be readily mounted on a wall or panel. The size of the recorder is 5 11/32 by 8 1/16 by 10 9/16 inches, and the weight 12 pounds. 53

Sundstrand Duplex Milling Machine for Small Parts

The Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill., has brought out a new small duplex type Rigidmil for milling two surfaces simultaneously on opposite ends of small work-pieces, such as lock, key, typewriter, gun, and business machine parts. This No. 0 size machine can also be employed for taking light cuts on larger work. It has two horizontal opposed spindle heads with independent vertical adjustment of 2 to 13 inches from top of table to center line of spindle. Thus, cuts on opposite ends of a part can be made at different relative heights.

Duplex Milling Machine for Small Parts Brought out by the Sundstrand Machine Tool Co.

The spindle heads are driven independently by either a 1- or 1 1/2-H.P. motor. The heads are available in two speed ranges of 25 to 1200 R.P.M. or 50 to 2400 R.P.M. Speed changes are obtained through pick-off gears and each set of two gears provides four possible speed changes.

In order to increase the range of work that can be handled on this machine, the columns that carry the spindle heads are mounted and keyed to wing or base members. For small parts, the columns are set in the inner position. For light cuts on larger parts, they can be relocated in either an intermediate or outer position. Thus, each column has three fixed positions, 1 3/4 inches apart, which provide a total increased spread of 7 inches between the spindle noses.

Each spindle is mounted in a quill which has a 1 3/4-inch endwise adjustment. With the columns in the inner fixed position, the minimum distance between spindle noses is 5 7/8 inches, and the maximum distance 9 3/8 inches. With the columns in the outer position, the minimum distance between spindle noses is 12 7/8 inches and the maximum distance 16 3/8 inches.

The machine table is 8 by 41 1/2

To obtain additional information on equipment described on this page, see lower part of page 248.

inches long, and has a maximum feed stroke of 12 inches and a table feed rate which is infinitely adjustable from 1/2 inch to 38 inches per minute. The rapid traverse rate is 325 inches per minute. Both feed and rapid traverse movements of the table are controlled by a Sundstrand hydraulic feed unit mounted in the machine base. The length of feed and rapid-traverse strokes is governed by adjustable dogs on the machine table. 54

Rayco High-Speed Quick-Change Chuck

A new high-speed production chuck for drill presses and hand power tools which permits quick, easy, and safe changing of tools without shutting off the power has been announced by the Rayco Mfg Co., 3911 S. Prairie Ave., Chicago 15, Ill. The chuck operates in all positions at any speed, and utilizes the principle of centrifugal force to move a ground and hardened driver into the adapter slot.

An upward movement of the outer sleeve of the chuck releases the centrifugal driver, permitting withdrawal of adapter and tool. When the next tool and its adapter have been put in place, the downward movement of the sleeve serves to release the centrifugal driver making the tool ready for operation. Tool changes can be made in three seconds at any speed up to 20,000 R.P.M. The chuck and its adapters are so designed that the tool is centered automatically. The centrifugal lock and self-centering features permit close-tolerance work at extremely high speeds. 55

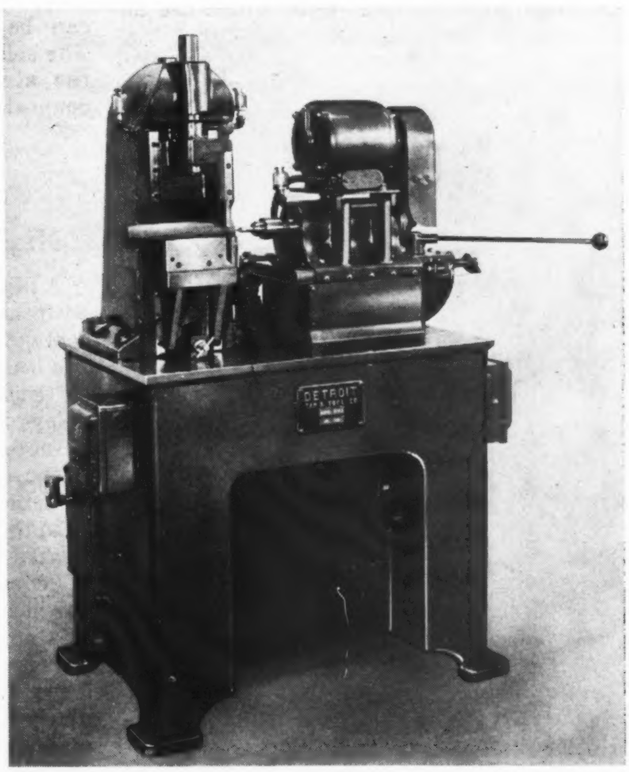
"Ace" Heavy-duty Tool and Cutter Grinder

Center-Drilling Machine with Self-Centering Vise

A center-drilling machine with automatic centering and clamping equipment designed for high production is a recent product of the Detroit Tap & Tool Co., 8432 Butler Ave., Detroit 11, Mich. Operation of the machine has been simplified to enable unskilled operators to do concentric centering on a wide range of stock sizes. A single lever controls all operations, including automatic positioning, clamping, and feeding of the drill.

The machine will produce concentric centers in bars of a wide range of shapes and sizes, including round and square stock ranging from 1/8 inch to 2 3/8 inches outside diameter, and up to any length that can be conveniently handled. The self-centering vise automatically clamps the work in concentric alignment with the centering drill. The vise is actuated by a hydraulic cylinder, which is controlled by a three-way valve operated by an extension of the feed-lever of the drill head. Two racks mating with a fixed pinion transmit opposed vertical motion of exactly equal amounts to the upper and lower V-block jaws of the vise.

The drill head is of the cartridge type with high-precision ball bearings, and travels on hardened and ground adjustable ball-bearing ways. The drill has three speeds—1250, 2400, and 5200 R.P.M.—obtained by a V-belt step pulley drive from the spindle-driving motor. Another motor drives the gear type hydraulic pump through a flexible connection. The spindle chuck has a center drill capacity of 1/8 to 1/2 inch.............56



Center-drilling Machine Placed on the Market by Detroit Tap & Tool Co.

Oliver Heavy-Duty Tool and Cutter Grinder

The Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich., has brought out an improved heavy-duty type of "Ace" tool and cutter grinder. The new machine is intended for the heavier work of "gumming" and "gashing" cutters and for use in grinding cutters tipped with tungsten carbide. It retains all the desirable features of the previous machine, but is equipped with a much heavier ram, larger ram bearing, a heavier motor, and a heavier spindle.

The same type of fixtures are used as on the standard Ace grinder but they are made of sufficiently heavy construction to handle the most rugged grinding work. The heavy-duty machine is equipped with a fixed diamond for truing the wheel to compensate for wear; means for grinding eccentric relief on milling cutters and reamers; and provision for obtaining correct clearance by direct reading. No special attachments are required for grinding all regular as well as many special milling cutters. 57

To obtain additional information on equipment described on this page, see lower part of page 248.

Watson-Stillman Presses

A new 250-ton double-action, drawing press with a single-action die and cushion cylinder (Fig. 1) is being manufactured by the Watson-Stillman Co., Roselle, N. J. The die ram of this machine is 11 inches in diameter and has a 14-inch stroke. When used as an ejector, the ram operates at a capacity of 3.9 tons on a pressure of 100 pounds per square inch.

This press is self-contained and is operated by a vane type oil-pump at a pressure of 2000 pounds per square inch. The platen is 48 inches square, and has an operating stroke of 36 inches. The machine is equipped for manual control and for single-cycle automatic operation. The driving motor operates on 440-volt, three-phase, sixty-cycle alternating current. The operating speeds are: Advance, 600 inches per minute; press, 82 inches per minute; and return, 725 inches per minute.

Another new press developed by the company is a 150-ton heating press (Fig. 2) with a stop-valve which locks in and holds the pressure for long periods, as required for many types of plastic hot-pressing and laminating operations. Among other features that adapt this press for many kinds of plastic heating operations is a separate radial piston constant-displacement pump with integral low-pressure gear pump. This pump can be placed in any convenient position near the press. The press is fitted with stand-pipe and flexible-hose connections for admitting steam and water to heat and cool the plates. It has a ram stroke of 16 inches; a platen 14 by 14 inches; an operating pressure of 2400 pounds per square inch; occupies a floor space of 5 feet 10 inches by 4 feet 1 inch; and weighs 6000 pounds. 58

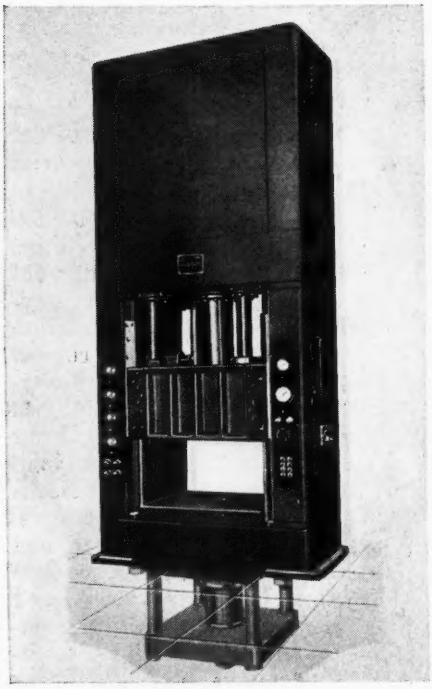


Fig. 1. Watson-Stillman Drawing Press with Cushion Cylinder

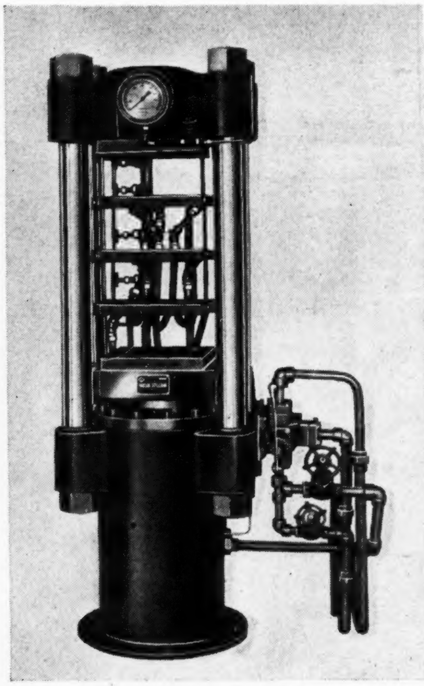
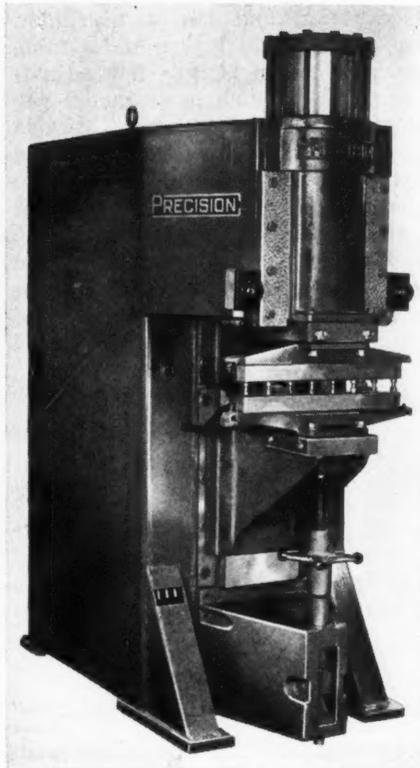


Fig. 2. Watson-Stillman Press for Hot-pressing Plastics

Press Type Precision Spot and Projection Welders

A new Type AVA (air vertical action) spot and projection welder, made in four standard sizes covering a range of from 30 to 500 KVA and pressures up to a maximum of 18,000 pounds, has been brought out by the Precision Welder & Machine Co., 138 E. McMicken Ave., Cincinnati 10, Ohio. This welder is constructed along machine tool lines, including unit assemblies, simplified installation features, and accessibility of the interior mechanisms. It has honed brass air cylinders with cushion and universal connection to the ram. The frame is of fabricated steel, the sides plain and unobstructed, and the overhanging arm is made an integral part of the frame to insure accuracy and rigidity.



Spot and Projection Welder Built by Precision Welder & Machine Co.

The extra long ram has V-ways with gibs, and is shrouded at the top to exclude dirt. Gibs which are adjustable for wear are designed to provide full-length lubrication.

Visible adjustable coolant flow, air-gage pressure regulator, and a selector switch are features of this machine. The vertical screw support can be used for knee adjustment. The solenoid valve is removable from the air terminal unit without disconnecting any piping. 59

"Vasco Supreme" High-Speed Cutting Steel

A high-speed steel cutting material with an exceptionally high carbon content, known as "Vasco Supreme," has been patented and recently placed on the market by the Vanadium-Alloys Steel Co., Latrobe, Pa.

Increased hardness and wear resistance provided by the high carbon content and the addition of 5 per cent vanadium, which also prevents brittleness, together with the addition of cobalt to give improved "hot-hardness" qualities, are said to make this new cutting material exceptionally useful in machining hard cast irons and cast steels. It is particularly suitable for machining these materials where rapid tool wear has previously been experienced due to the abrasive condition of the surfaces machined.

To obtain additional information on equipment described on this page, see lower part of page 248.

The new cutting steel has been tested with very satisfactory results in single-point lathe tools and screw machine tools, flat and circular form cutters, broaches, drills, and inserted-blade milling cutters for machining such materials as Bessemer screw stock, cold-rolled steel, cast-alloy steel, hard cast iron and high-carbon tool steel. 60

Six-Spindle Valve-Seat Grinding Machines

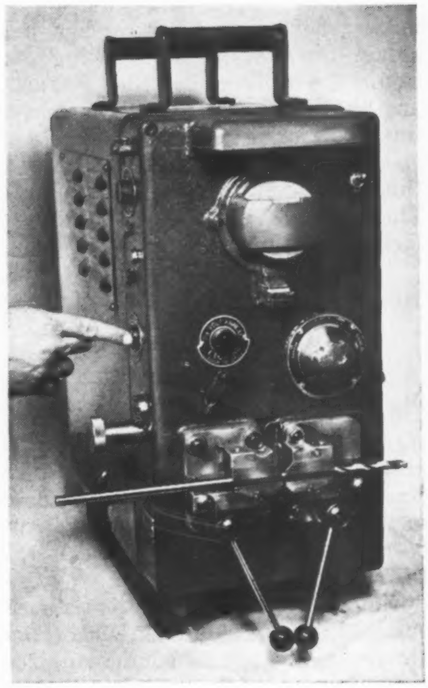
The Milwaukee Cock Grinding Machine Co., 2357-S N. 29th St., Milwaukee, Wis., has brought out two improved six-spindle valve-seat grinding machines designed for grinding and lapping the seats of a large range of sizes and a wide variety of tapered valve cocks. Valves for all pipe sizes from 1/8 inch to 1 1/2 inches, including those for steam, air, gases, liquids, and railroad cut-out and single-valve cocks, can be handled. The machines grind and lap up to 300 valve seats per hour, depending upon the size. Only one man is required for each machine.

The machines will grind six different types of valves simultaneously, and each spindle can be loaded individually. The Model B machine is provided with two-jaw chucks for grinding valves with flats on the stems, and the Model C is equipped with heat-treated alloy-steel collets for gripping round valve stems. Collets are available with grips up to 1 inch in diameter. 61

DoAll Automatic Flash Butt-Welder

A new portable automatic flash butt-welder designed for the production welding of bar and round stock up to 5/16 inch in diameter is being manufactured by the DoAll Co., 1301 Washington Ave., S., Minneapolis 4, Minn. This welder is adapted for a wide variety of uses, including the repairing of small tools, the butt-welding of tool bit extensions and shanks, and the joining of band-saw blades ranging from 1/16 inch to 1 1/4 inches in width. Time-saving features include the built-in grinder for weld dressing; automatic motor-controlled feed of material; and cam-operated lever method of clamping.

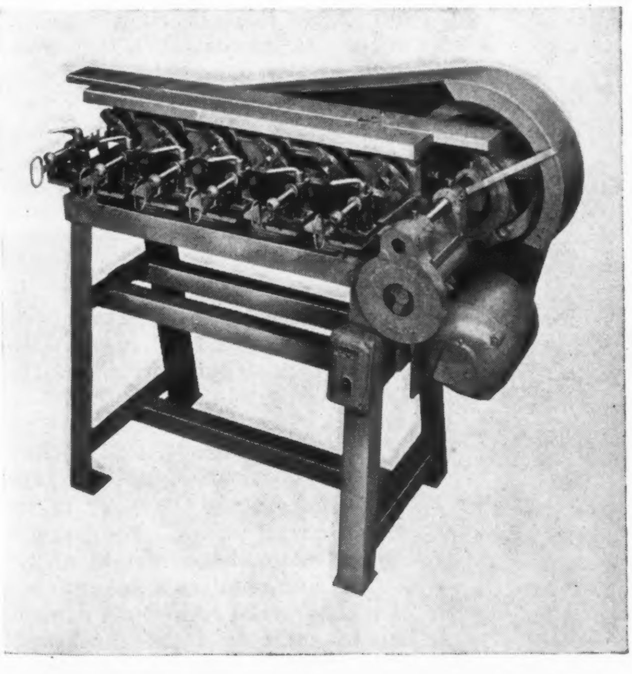
Welding is fully automatic, the complete cycle being controlled by a single push-button switch. In addition to welding, annealing, and flash dressing, there is an attachment for etching identification marks on workmen's tools, templets, attachments, jigs and fixtures, etc. This welder is designed for operation on 220-volt alternating-current, single-phase, 50- to 60-cycle lines, but it can be supplied to meet other voltage requirements. It is available in either a pedestal type or in a portable type with metal carrying case. 62



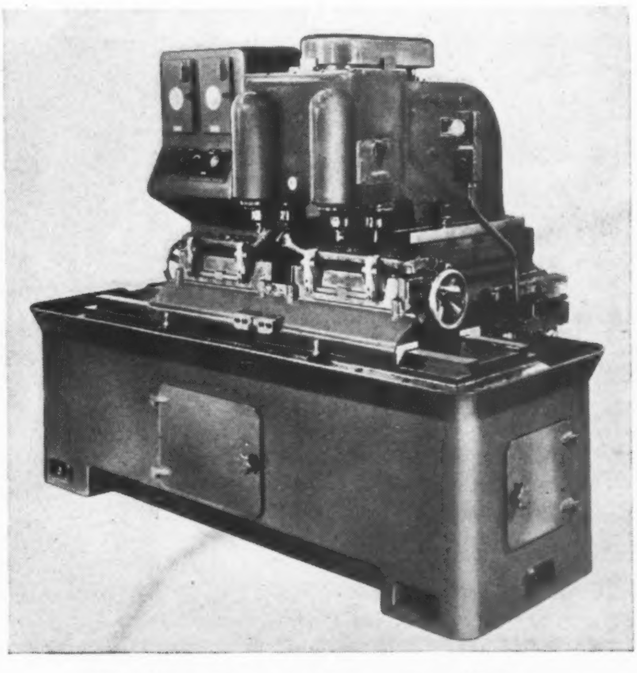
DoAll Automatic Flash Butt-welder

"Hy-Mac" Two-Stage Boss-Milling Machine for Cylinder-Head Castings

A special-purpose two-stage machine for milling the bosses on cylinder-head castings has been brought out by Hydraulic Machinery, Inc., 12825 Ford Road, Dearborn, Mich. This machine is hydraulically operated and electrically controlled. The operating cycle consists of manually loading and unloading parts at one station while the



Milwaukee Six-spindle Valve-seat Grinding Machine



"Hy-Mac" Two-stage Boss-milling Machine

To obtain additional information on equipment described on this page, see lower part of page 248.

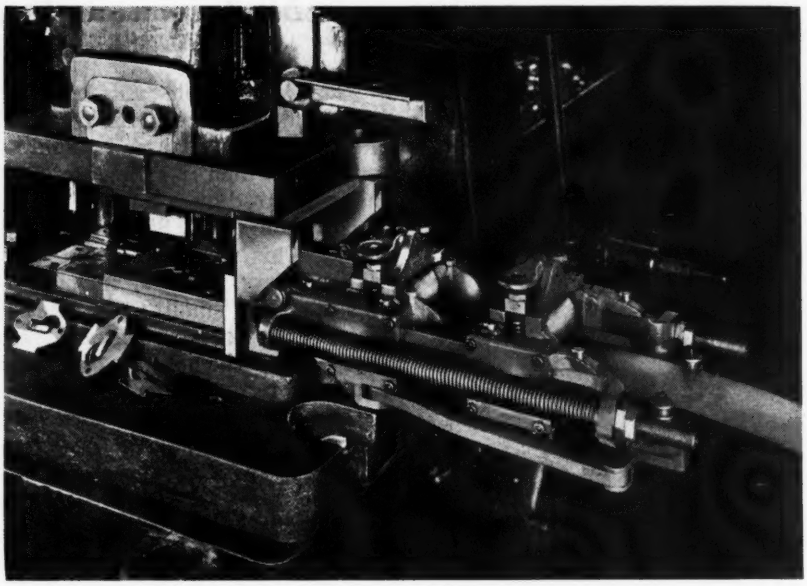
milling head moves inward and machines the part at the working station. The milling head then retracts, and the newly loaded part is moved into the work station. This cycle of operations is repeated at a production rate of ninety pieces per hour. The machine is 48 inches wide, 60 inches high, and 72 inches long.....63

Dickerman Die Feeds for Punch Presses

Two new punch press feeds designed to provide more complete coverage of the wide range of stock sizes and feed lengths encountered in the metal-stamping industry have been added to the line of the H. E. Dickerman Mfg. Co., 321 Albany St., Springfield, Mass. These new developments, known as 6-inch Dickerman die feeds, are available in two sizes —one for feeding coiled strip in any practical combination of thickness and width up to 3/16 inch thick and 4 inches wide and one designed for handling coiled strip in any practical combination of thickness and width up to 3/16 inch thick and 6 inches wide.

The maximum feeding length for both of these feeds is 6 inches on presses having a stroke of 3 inches or more, and approximately double the press stroke on other presses. This increase in range of feed lengths is especially desirable for use where only short-stroke presses are available or where, due to limitations imposed by the die, the effective feeding portion of the press stroke is greatly reduced. Feed lengths are adjustable from 0 to a maximum of 6 inches in increments of 0.001 inch.

These feeds can be installed quickly and easily on almost any type of punch press, and can be placed on the die set or bolster plate in any position for any style of die. A twin operating cam is furnished for attachment to the punch-holder or press ram. Since these feeds require no connection to the power shaft of the press, the feed and required die set can be easily set up on any idle press. This is particularly advantageous on rush or short-run work.......64

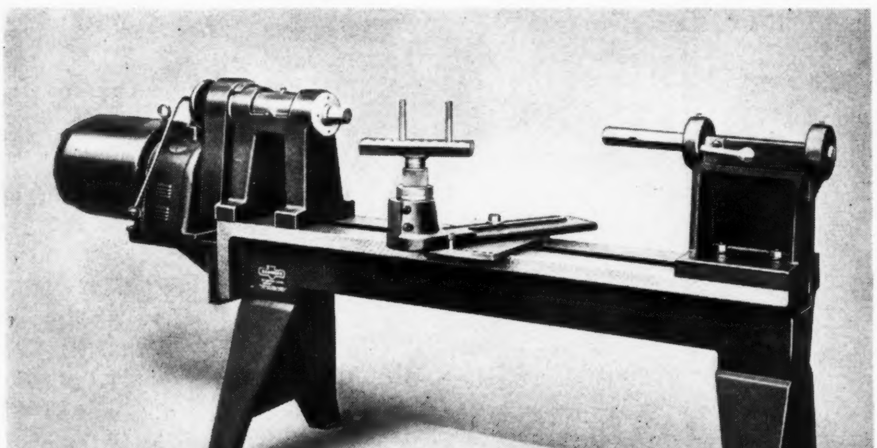


Dickerman Stock Feed Applied to Punch Press

Ermac Metal-Spinning Lathe with Positive-Lock Adjustable Tool-Rest

A metal-spinning lathe has just been placed on the market by the Ermac Co., 5531 S. Vermont, Los Angeles 37, Calif. Several new features designed to insure safer operation have been incorporated in the design of this machine. Two of these features, for which patent applications have been made, include a new positive-lock adjustable tool-rest and a positive-lock rotary cam-operated tailstock. A third feature is heavy-duty taper roller bearings which run in oil. A two-speed 5-H.P. motor with a four-speed Lima drive provides eight spindle speeds ranging from 205 to 1730 R.P.M. Changes from low to high speed or vice versa can be made without stopping the spindle, by means of a push-button control.

Specifications for the new lathe are: Swing, 27 inches; length of straight bed, 6 feet; distance between centers, 32 1/2 inches; outside diameter of front spindle bearing, 3.671 inches, and inside diameter, 2 inches; outside diameter of rear bearing, 3.548 inches, and inside diameter, 1.437 inches; tailstock taper, No. 3 Morse; and diameter of tailstock shaft, 2 inches. The lathe, including motor, has a weight of 2000 pounds, and requires a floor space of 24 inches by 96 inches. A complete line of spinning tools, chucks, and forms of all types can be supplied for use with this lathe. 65



Metal-spinning Lathe Placed on the Market by the Ermac Co.

To obtain additional information on equipment described on this page, see lower part of page 248.

Press for Assembling Camshaft Bushings in Motor Block

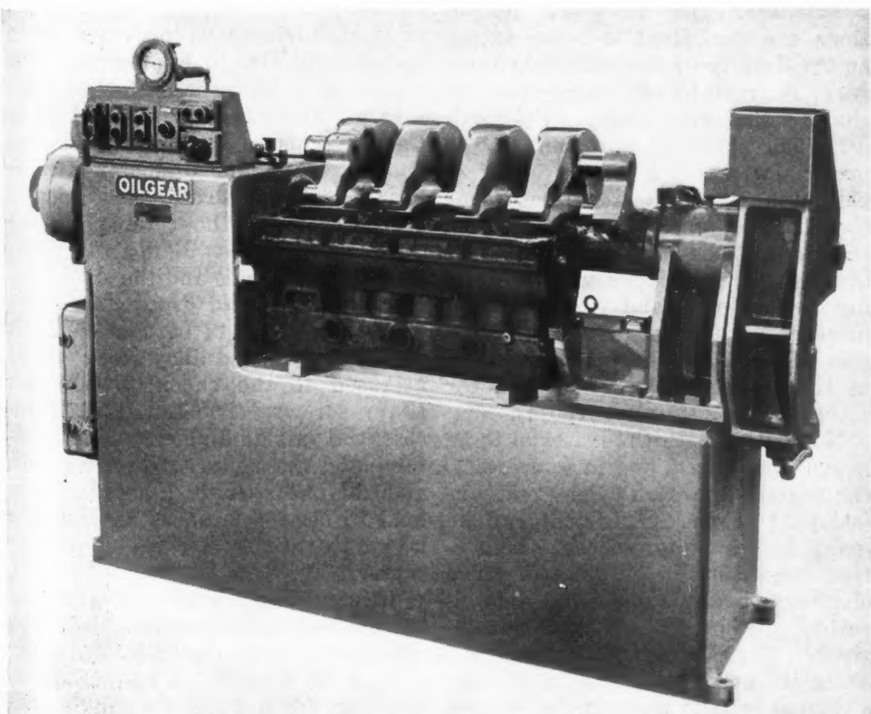
Five different sizes of camshaft bushings can be assembled in an eight-cylinder motor block in one operation on a 15-ton press recently built by the Oilgear Co., 1312-A W. Bruce St., Milwaukee 4, Wis. This press is a production-line machine, and is designed for loading the work at conveyor-line height. It is semi-automatic in operation, interlocked, and provided with electro-hydraulic control. The pressing and return speeds are variable, and there is an alternative push-button control.

In operating this machine, it is only necessary to slip the camshaft bushings on locating pins and guide the motor block into the assembly position. From then on, the operation is automatic. Without any further attention from the operator, a small hydraulically actuated plug automatically advances and enters the end bushing hole to locate the block in its correct angular position. A hydraulically actuated rack and pinion then rotates the bushing bar to lower the bushings until they are in alignment with the camshaft bearing holes and to bring a set of large guide pins in line with the front and rear main bearing holes. Next the main ram pulls the bushing bar forward to position the motor block accurately on the guide pins, which enter the main bearing holes as the five camshaft bearings are pressed into place. As soon as this operation has been completed, the main ram pushes the bushing arm backward, and the hydraulically actuated rack and pinion rotates the bushing bar, raising the bushing locating pins to their original loading positions and thus completing the automatic cycle.

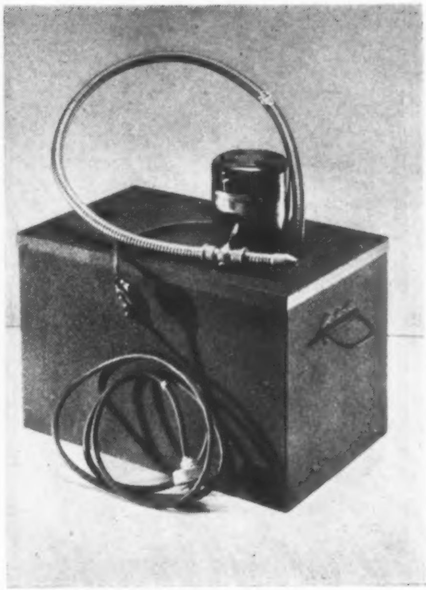
After the motor block with its assembled camshaft bearing bushings has been guided onto the conveyor, another set of bushings is placed on the locating pins and a new cylinder block is guided into position. The press then automatically repeats the assembling cycle.

Semi-automatic operation of the press is accomplished by pressing a single push-button. However, the electric-hydraulic control is so interlocked that the bushing bar is not rotated into the assembling position nor pulled inward to press the bushings into place until the operator has placed the bushings on the locating pins and guided the motor block to the assembling position.

An Oilgear two-way variable-delivery pump connected directly to a 7 1/2-H.P. electric motor furnishes fluid power for operating the locating plug ram, the rack-and-pinion cylinder, and the main bushing bar cylinder. A three-position electric remote pump control provides independent pressing and return speed adjustment. Electric switches and solenoid-operated valves direct the sequence of operations. 66



Horizontal Camshaft-bushing Assembling Press Built by the Oilgear Co.



Portable Coolant System Developed by Inject-A-Flow Pump Co.

Portable Coolant System for Machine Tools

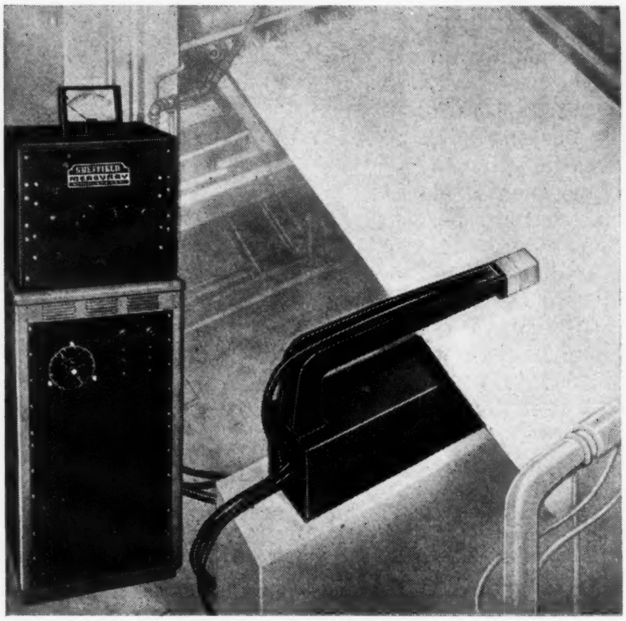
A self-contained filtering unit designed to remove all the fine metal particles held in suspension in liquid coolants used on machine tools has been incorporated in a new portable coolant system developed by the Inject-A-Flow Pump Co., 67 N. Willow St., Montclair, N. J. This system can be adapted to the requirements of any machine tool, including grinders. It is claimed that the strainer unit will exclude extremely fine particles, such as frequently cause damage to tools and coolant pump, and that it does not reduce the flow of coolant to the cutting tools.

The strainer unit is mounted inside a 7-gallon rectangular steel tank, and the pump unit is attached to the lid of the tank, with the pump operating inside the strainer unit. The pump unit consists of a precision cast non-corrosive centrifugal pump connected to the motor through an extended shaft. Provision is made for recirculating the coolant liquid. The system is equipped with 4-foot Wheelock flexible metallic hose and a bronze flow-control valve, together with the necessary wiring and switch. 67

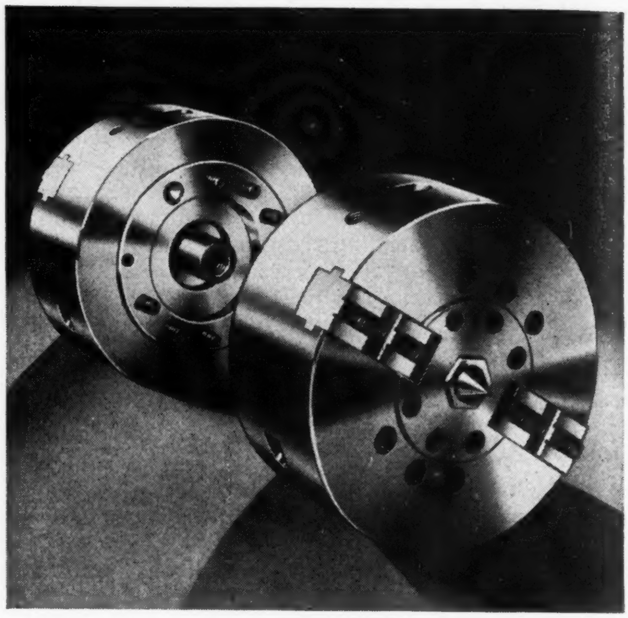
Flexible Polishing Wheel

The Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J., has added a series of flexible, soft polishing wheels to its line of metal-finishing equipment. The

To obtain additional information on equipment described on this page, see lower part of page 248.



Sheffield "Measuray" Employing X-rays and Electronics for Checking Thickness of Moving Material



Two-jaw Power Chuck with Center Designed to Support and Drive Work Requiring Heavy Cuts at High Speed

new wheels are bonded with an especially modified compound of Neoprene impregnated with abrasive grain to obtain a high degree of flexibility and cushioning action.

The patented, closely controlled method of manufacturing this Neoprene wheel makes it possible to vary the wheel densities over a wide range to suit specific applications. The combination of porosity and soft bond is claimed to result in a wheel that gives superior finishes. The nature of the bond used for such wheels limits the speed to 3000 surface feet per minute. The wheels are especially adapted for use on stainless steel, glass, non-ferrous metals, and precious metals. The bond material is supplied in the finer abrasive grain or with pumice, rottenstone, or other mild abrasives, and can be used effectively in blocks and rubbing pads, as well as in the wheel form...........68

"Measuray" for Continuous or Spot Checking of Thickness of Moving Materials

A remarkable new gaging instrument known as the "Measuray" is being offered to industry by the Sheffield Corporation, Dayton 1, Ohio, which has acquired exclusive manufacturing and sales rights for this equipment. The "Measuray" utilizes an entirely new X-ray and electronic application for non-contact, continuous, or spot checking of the thickness of all types of moving materials. It can be applied to almost any production process for checking such materials as brass, copper, steel, aluminum, or any other metal; paper, plastics, composition material, film, rubber, sheet cellophane, or foil of any kind. Metal foil can be checked for thickness to an accuracy of 1 per cent as easily as sheet materials 3/16 inch thick. Concentricity can also be determined in checking work such as a wire surrounded by insulation.

Tolerance and thickness limitations are dependent to some extent on the density of the material. Accuracy is maintained regardless of changes that may occur in the product. The speed of movement of the material, whether 5 feet or 5000 feet per minute, and the temperature of the room or stock do not affect the accuracy of the instrument. Standard units are equipped with indicating mechanisms, and recording and machine control devices are available. Masters of the same material as that to be checked are used for set-up and operating purposes.

No contact with the material to be gaged is required, and in some cases, the nearest approach of any mechanical part of the instrument can be many inches away, so that destructive inspection is eliminated. The electronic power supply and amplification units may be set wherever desired. Four standard "Measuray" units are available. Thickness, density, and type of material, as well as tolerances, determine which of the four units is to be applied...............69

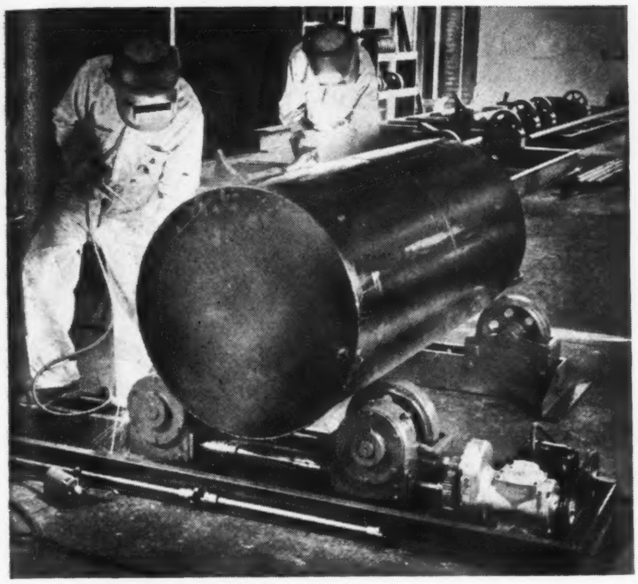
Skinner Power Chuck with Center for Taking Heavy Cuts at High Speeds

A two-jaw compensating power chuck designed to drive work on centers where exceptionally heavy cuts are to be taken with carbide tools at high spindle speeds has been added to the line of the Skinner Chuck Co., 342 Church St., New Britain, Conn. Compensating action of the jaws sufficient for gripping rough-forged or cast surfaces is provided by a rocker attached to a plunger. The center is of high-speed steel and fits into a standard Morse taper hole in the center plate. A thin nut, threaded on the maximum diameter of the tapered section, permits easy removal of the center without removing the center plate. The two "floating" jaws are non-adjustable and the solid jaws have a tongue and groove.

The center plate of this chuck is made of hardened alloy steel, and is attached to the chuck jaw by six heavy screws. The center plate recess, the outside diameter of the center plate, the center, the center seat, and all other critical surfaces are held to close tolerances to insure a highly accurate work-supporting center.

This new chuck is now available in an 8-inch diameter size for a Type A6 spindle, and in a 12-inch size for a Type A8 spindle. A 10-inch diameter size for a Type A6 spindle and a 15-inch size for a Type A11 spindle will soon be available.................70

To obtain additional information on equipment described on this page, see lower part of page 248.



Reed Rotating Rolls for Welding Operations

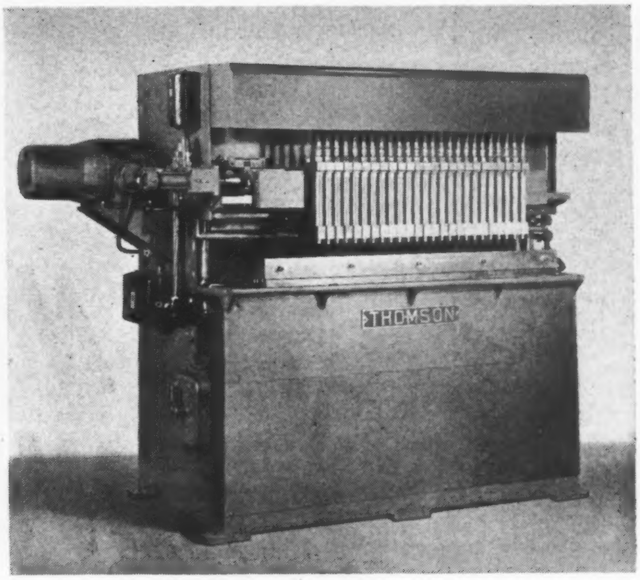


Fig. 1. Thomson "Ultra Speed" Spot-welder

Reed Turning Rolls for Tank-Welding Operations

The Reed Engineering Co., 201 E. Broadway, Webb City, Mo., has recently placed on the market a Model 60 set of work-rotating rolls comprising power and idler units for the rotation of cylindrical tanks or other products that are to be manually or automatically welded. The power unit has a 1/2-H.P., three-phase motor, and is built with a dial-controlled variable-speed drive to provide the exact welding speed required for any kind or thickness of material. Both power and idler units can be quickly adjusted for rotating cylindrical work of any diameter.

The weight-carrying capacity of the standard set, consisting of one power and one idler unit, is 6000 pounds. When additional capacity is required, extra idler units can be obtained, each of which has an additional capacity of 3000 pounds. These units are regularly equipped with rubber-tired wheels, but solid steel or cast-iron wheels are available...71

Thomson "Ultra Speed" Welder for Fabricating Wire Mesh

An "Ultra Speed" spot-welder designed primarily for welding wire mesh, such as is used for grilles, racks, trays, and similar products, is a recent development of the Thomson Electric Welder Co., Lynn, Mass. This welder is adapted for mass production jobs involving large numbers of similar welds that are closely spaced on a uniform surface. The welder shown in the illustration has twenty-five electrodes, arranged to weld up to twenty-five longitudinal wires, spaced as desired up to a maximum width of 48 inches. The machine has a normal capacity for welding wires ranging from 14 gage up to No. 0 gage.

Longitudinally positioned wires can be fed into and through the machine continuously if desired. Spot-facing can be varied from a minimum of 1 1/2 inches between welds up to any desired width. Wide spacing, which requires fewer electrodes for the maximum work width accommodated by the machine, is accomplished without removing electrodes, by means of individual cut-out valves.

For welding work of a diamond-mesh or diagonal-weave pattern, a shuttle bar operated by a hydraulic cylinder is employed to move the entire bank of electrodes to the right or left of the initial position.

Two 50-KVA transformers with individual heat regulators and Weld-O-Trol controls provide welding current, the current being applied in rapid succession to pairs of electrodes as the carriage of the unit moves across the machine. Welding pressure is applied by a motor-driven hydraulic pump. The pressure is applied simultaneously to all electrodes, and is maintained during the complete cycle. Both pressure and current dwell periods are individually adjustable to suit any electrode, so that mesh welding operations involving several different gages of wire can be performed efficiently.

Operation of the machine is started

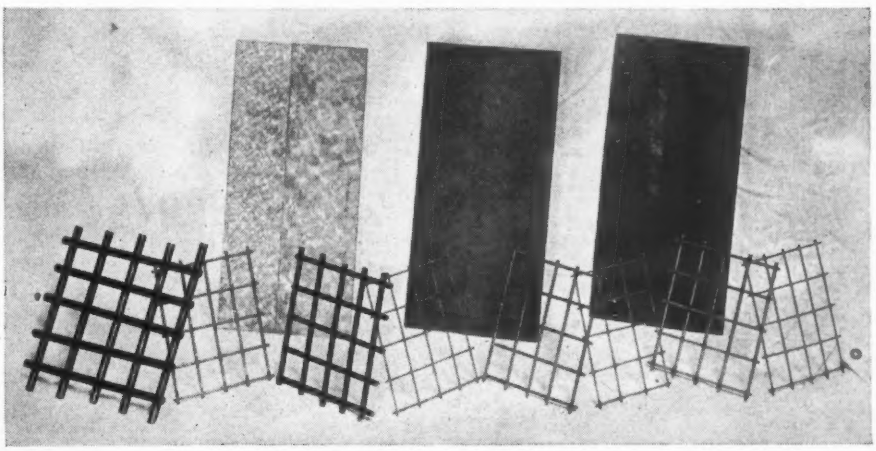


Fig. 2. Samples of Wire Mesh and Sheet-metal Work Produced by the Welder Shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 248.

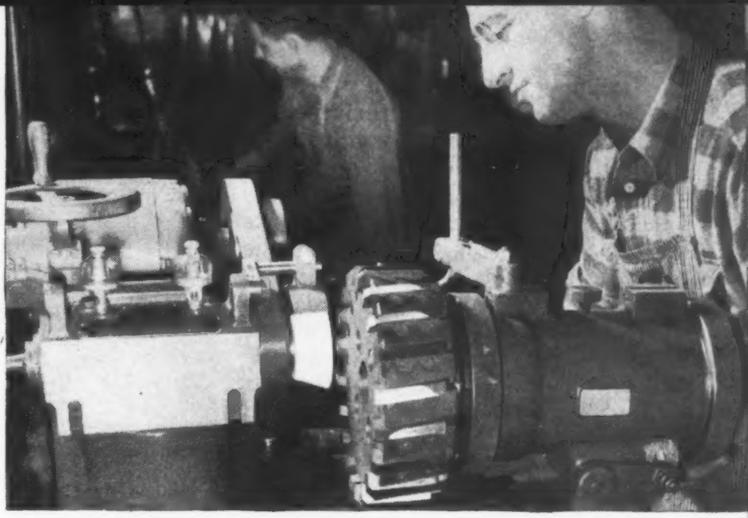
The No. 10 Makes it to SAVE on CUTTER

Designed for operation from front of machine. Controls and adjustments on the No. 10 are all within easy, natural reach. Vertical adjustment handwheel is centered immediately above on the spindle head.

BS

BROWN &

EASY SHARPENING

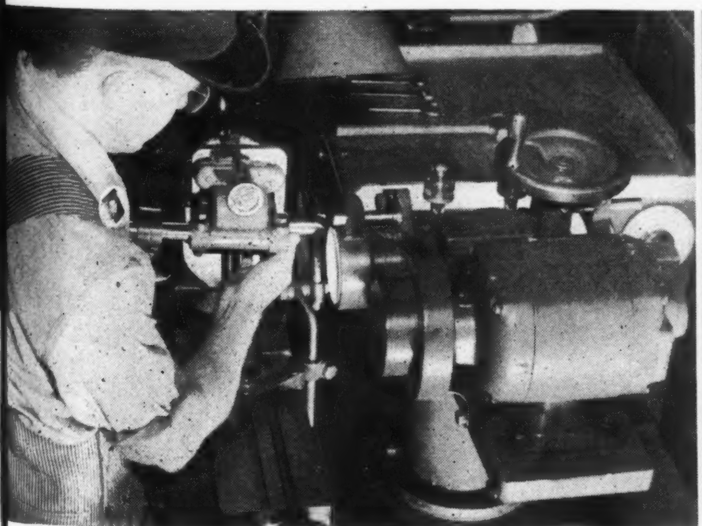


Many available attachments broaden .. scope of this general cutter grinding machine. The Face Mill Sharpening Attachment for example (shown above) permits face mills up to 14" diameter to be sharpened.

With the No. 10 it is easy to sharpen tools rapidly and accurately at savings in time and money. You'll get more production out of correctly sharpened tools . . . longer tool life . . . and the tools will spend more time cutting and less time being sharpened.

The No. 10 Cutter and Tool Grinding Machine is designed specifically for the rapid, accurate sharpening of plain milling cutters (straight and helical), formed cutters, straddle and face mills, angular cutters of any angle, side milling cutters, end mills, straight or tapered reamers and saws. Other types of grinding, such as internal, straight and taper cylindrical are readily handled by means of additional equipment. Write for descriptive literature. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

Work mounted between centers to be ground at an angle is accurately positioned by setting the swivel table. Convenient hand lever can be used to give a 4" table reciprocation at any point in the path of travel.

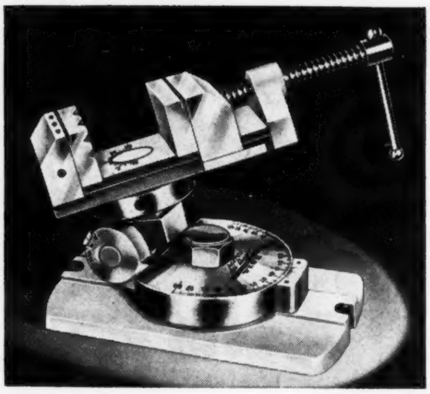


Accurate clearance angles are readily obtained by vertically swiveling the universal head.

Plain cutters may be sharpened by being mounted on a sliding shell on the cutter bar of the universal head.

SHARPE

by tripping a floor switch. The two sections of the carriage driven by a worm and reversing motor move across the machine, each section of the carriage firing half the electrodes in rapid succession. A solenoid brake automatically stops rotation of the driving motor at the limit of travel, and the electrode pressure is released. The next contact of the floor switch serves to repeat this sequence of operations for the second series of spots with the carriage moving in the opposite direction. 72



Matco Precision "All-Angle" Vise

Precision Vise for Toolmakers and Diemakers

The Matco "All-Angle" vise recently brought out by the Machinists Tool Co., 2834 W. Lake St., Chicago 12, Ill., is designed to hold work at practically any required angle. It is especially suited for die, gage, and fixture drilling and grinding work. The vise can be set in the vertical position without interference from the base. Double swivel construction permits setting the work to any horizontal position. It is adaptable for use on grinders, drill presses, and machine tools, as well as for bench applications.

The vise is made in plain, plain swivel base, and air production models, as well as the model illustrated, which is available with 3 1/2- or 4 1/2-inch jaws. Jaws with V-grooves are provided, in addition to the regular hardened and ground replaceable jaws. The vise swivels 360 degrees on the base, and has a 90-degree vertical angle adjustment. It is equipped with a floating jaw to insure instant and positive gripping of the work. 73

Weltronic Induction Heaters of Improved Design

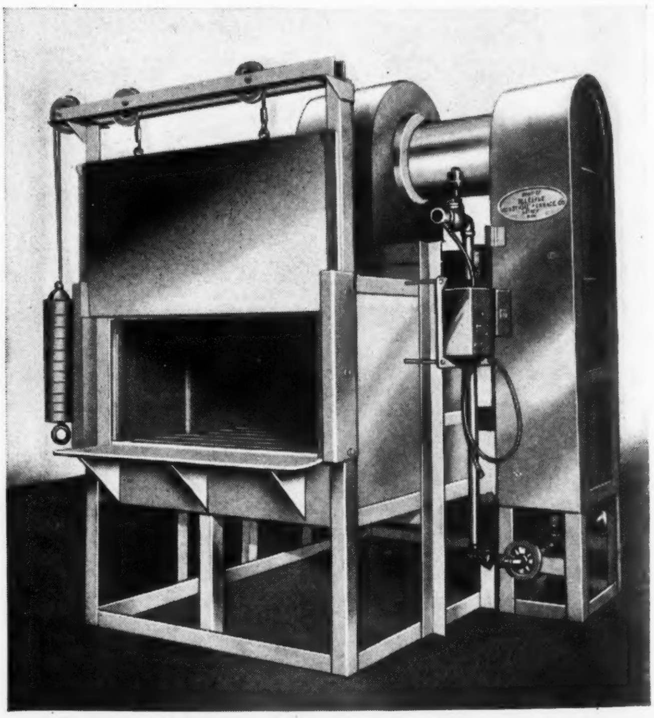
A new line of induction heaters has been brought out by the Weltronic Co., 19500 W. Eight Mile Road, Detroit 19, Mich. Features incorporated in these electronic high-frequency generators include rigid steel frame construction; aluminum paneling designed to reduce power loss; blower for cooling, which forces filtered air into the double wall between the oscillator and rectifier sections and to all heat producing parts by means of properly placed perforations; three-phase power supply induction generator; nitrogen-filled tank condenser designed to simplify refilling; and interlock for each door to insure safety. Any auxiliary equipment required to solve individual production problems, including work coils, work-tables, and fixtures, can be designed and built by the Weltronic Co.

These induction heaters are particularly adapted for hardening and heat-treating parts such as gears, tools, dies, gages, cams, bearings, shafts, and rods. They are also suitable for silver or copper brazing, soldering, forging, piercing, and melting operations. 74

Bellevue Heat-Treating Furnace for Aluminum Alloys

A batch type furnace designed for heat-treating aluminum alloys, which has an atmospheric type burner mounted on the lower end of the duct for recirculating the air back into the furnace, has been added to the line of the Bellevue Industrial Furnace Co., 2917 Bellevue, Detroit, Mich. A high-temperature fan is used as standard equipment for circulating the heated air. It is claimed that this method of heating main-

Induction Heater Built by Weltronic Co.



Bellevue Heat-treating Furnace for Aluminum Alloys

To obtain additional information on equipment described on this page, see lower part of page 248.

tains an exceptionally uniform temperature. The mounting of the burner on the duct also serves to eliminate the need for an extra heating unit. 75

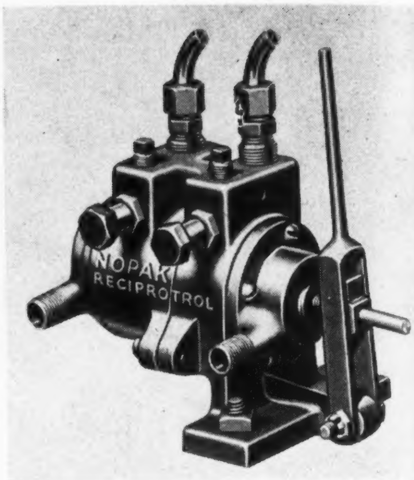
Strauss Hot Powdered-Metal Press

The National Diamond Hone & Wheel Co., 108 Fulton St., New York 7, N. Y., has announced the development of a machine for hot-pressing all types of non-ferrous metal and metal-alloy powders, which incorporates designs originated by Harry L. Strauss, Jr. This press employs a resistance-heated carbon die which applies heat and pressure to the powdered metal simultaneously. It is especially designed to enable manufacturers to develop and produce in their own laboratories powdered-metal alloys to suit the requirements of their particular products.

With this press, such metals as copper, tin, nickel, and zinc in powdered form can be alloyed and hot-pressed under adjustable heat and pressure conditions to produce alloy metals having a wide range of applications. For example, an alloy of copper, tin, nickel, and titanium hydride, developed by the manufacturer of the press, is said to give exceptional results as a bonding agent in the production of special metal-cutting tools. The press is especially adapted for use in the production of corrosion-resistant metal of high density, such as is often required in laboratory experimental work and production operations.

The laboratory model press, shown in Fig. 1, is mounted on a small stand to facilitate moving it to any convenient position in the laboratory or tool-room. It weighs 150 pounds, and measures 24 by 24 by 36 inches. Resistance heating of the carbon die is accomplished by simply connecting the heating unit to a 115-volt alternating-current circuit.

In addition to furnishing the laboratory model press described, the manufacturer is prepared to build larger machines of the same type and to cooperate with the engineering departments of other companies who may desire to design hot powdered-metal presses to suit their particular requirements or who desire consulting service in the development of special powdered-metal alloys.........76



"Nopak" Reciprotrol Valve for Controlling Speed and Stroke of Air-cylinder Piston

Valve for Controlling Speed and Stroke of Air-Cylinder Pistons

A "Nopak" Reciprotrol valve recently introduced on the market by the Galland-Henning Mfg. Co., 2775 S. 31st St., Milwaukee 7, Wis., is said to provide a combination of control features not previously available in a single four-way valve. This valve can be used to operate any size or make of air or oil hydraulic cylinder at line pressures from 50 to 300 pounds, providing means for positively regulating the air stroke speed in both directions independently. For example, a double-acting cylinder can be operated at maximum speed in one direction and at one-fourth maximum speed on the return stroke. In addition, it permits a choice of cycle speeds from 0 to 500 complete cycles per minute, depending upon the bore and stroke dimensions of the cylinder.

The Reciprotrol valve is adaptable to full-automatic, semi-automatic, or manual operation. It is self-tripping, and will operate at speeds up to 500 reciprocations per minute on small-diameter short-stroke air cylinders. Piston travel stops are made at precisely the same point on each stroke through the instantaneous reversing action of the ring valve.

The 3/8-inch pipe size is suitable for most oscillating applications. In addition to operating any size or make of double-acting cylinder, it can be used to operate two single-acting spring-return cylinders. It

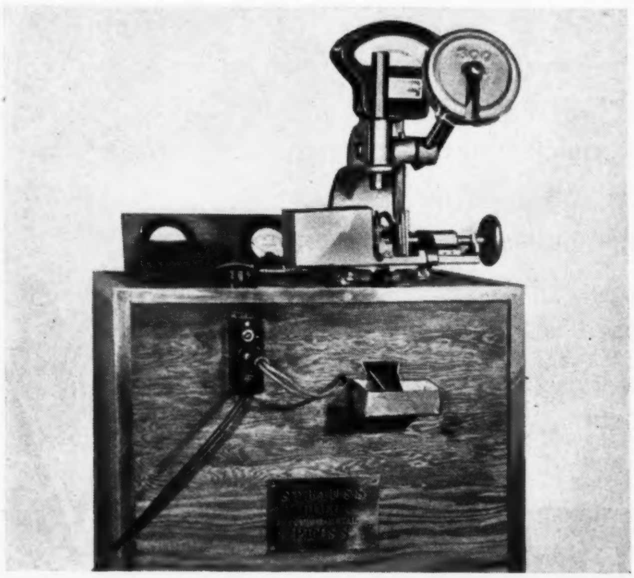


Fig. 1. Strauss Hot Powdered-metal Press Manufactured by the National Diamond Hone & Wheel Co.

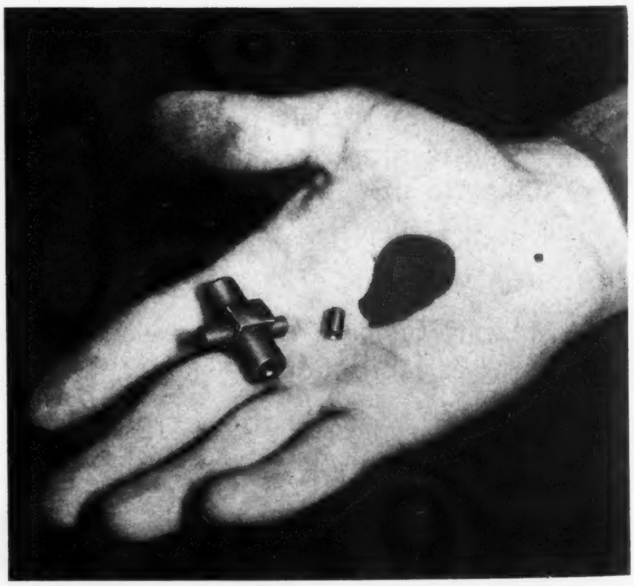


Fig. 2. Carbon Die Used in Strauss Press to Produce Cylindrical Piece (Center) from Powdered Metal (Right)

To obtain additional information on equipment described on this page, see lower part of page 248.

RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

● *Equal Efficiency of Every Unit Makes the Balanced Machine.*

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9. Ohio U.S.A.

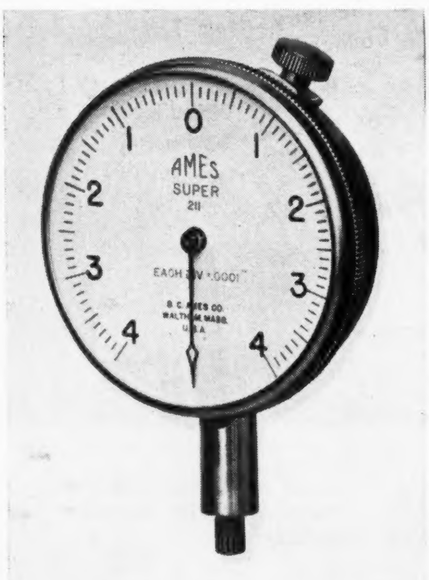
can also be set up in batteries to operate a large number of cylinders simultaneously. 77

Ames Super-Sensitive Dial Indicators

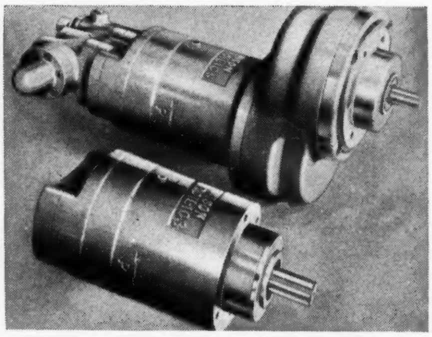
A new series of extremely sensitive and accurate master checking dial indicators, called the "Super," is being manufactured by the B. C. Ames Co., Waltham 54, Mass. The over-all bezel diameters of the new models are the same as those of the Ames 200 and 300 series, namely, 2 1/4 and 2 3/4 inches, respectively. The graduations are 0.0001 inch, and the range is 0.008 inch. The indicators are available with dials of either the balanced (4-0-4) or the continuous (1-0-8) type. Every bearing is jeweled.

Very low values of both internal friction (less than 10 grams) and contact pressure (50 grams) enable the indicator to follow variations in dimensions as small as 0.00001 inch. The readable accuracy is one-fourth of a division, or 0.000025 inch.

The new indicators are adapted for use as a master check, both in the tool-room and on the production line. Equipped with diamond contact, they can also be used as surface analyzers to check trueness and finish of ground surfaces, chatter of tools or work, etc. All outside diameters of these indicators are in accordance with American Gage Design Committee standards. A variety of backs, to suit the desired mounting, is available. 78



"Super" Dial Indicator Manufactured by B. C. Ames Co.



Variable-speed Fluid Motor Brought out by the Denison Engineering Co.

Denison Variable-Speed Fluid Motor

Variable speed combined with instant speed-up control to meet any rapid traverse requirements are features of a rotary axial piston fluid motor of radically new design brought out by the Denison Engineering Co., 1152 Dublin Road, Columbus 16, Ohio. This fluid motor is available in 3- and 5-H.P. capacity sizes; with or without a speed control valve; with or without a choice of geared-head units having various gear ratios; and with brackets of various designs for mounting the motor in any position desired.

The "floating drive" feature of the motor serves to maintain constant pressure contact between the driving and driven elements without the use of mechanical linkages or connecting-rods. This is said to eliminate the destructive effects of backlash or inertia resulting from sudden starting, stopping, and reversing, as required in the operation of indexing tables and similar equipment. The motor is self-starting; operates with equal efficiency in either direction; can be instantly reversed; and is self-lubricating.

When equipped with speed control valve, the motor can be preset to operate at any speed within its capacity. Infinite speed variations are obtained by the adjustment of a knurled knob on the side of the valve. When used without a speed control valve, and driven by oil from an independent pumping unit, the speed can be accurately regulated by adjusting the volume of oil delivered to the motor. 79

Texaco Soluble Cutting Oil and Gear Lubricant

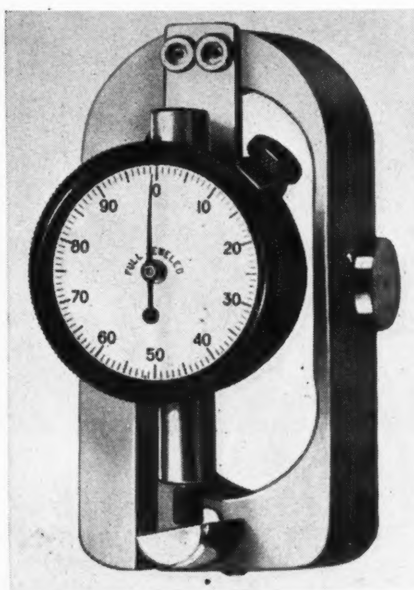
A cutting oil known as the Texaco "soluble oil heavy duty" has recently been developed by the Texas Co., 135 E. 42nd St., New York 17, N. Y. This oil is said to have the excellent cooling properties of soluble oils, combined with the high-speed cutting characteristics of sulphurized mineral oils, and thus permits much higher cutting speeds.

The Texas Co. has also brought out a new gear lubricant which can be easily brushed or sprayed on open gears. This lubricant, called "No. 2-X Fluid," contains a base material that has high adhesiveness, cut back with a non-inflammable solvent. This combination is said to result in a lubricant that is both efficient and easy to apply. 80

Dillon Mechanical Pressure Gage

A mechanical pressure gage of compact size has been brought out by W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago 44, Ill., for accurate testing work. This gage is made in a 0-100 pound model measuring 3 5/8 inches long by 2 7/32 inches high by 1 3/4 inches wide, which weighs only 1 1/4 pounds; and in 0-250, 0-500 and 0-1000 pound models all measuring 4 5/16 inches long by 2 7/16 inches high by 2 5/16 inches wide. The latter gages weigh 2 pounds each. The 0-2500 and 0-5000 pound models are 4 5/8 inches long by 2 3/8 inches high by 2 3/4 inches wide, and weigh 2 1/2 pounds. All models are furnished with a strong wooden carrying case.

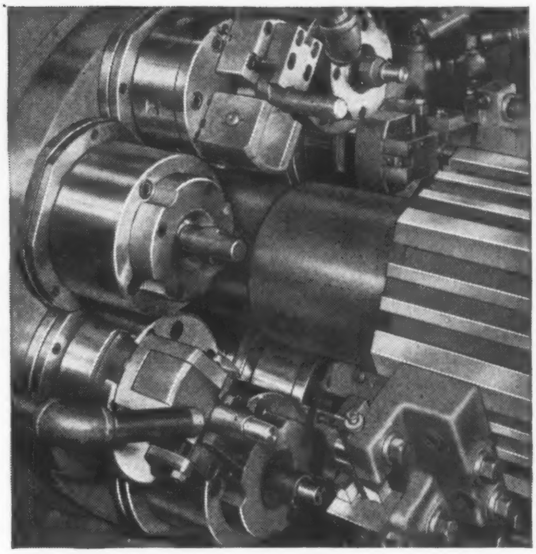
The wide range of applications for which these gages are adaptable in-



Mechanical Pressure Gage Brought out by W. C. Dillon & Co.

To obtain additional information on equipment described on this page, see lower part of page 248.

LEADERSHIP BASED ON ACCOMPLISHED FACTS

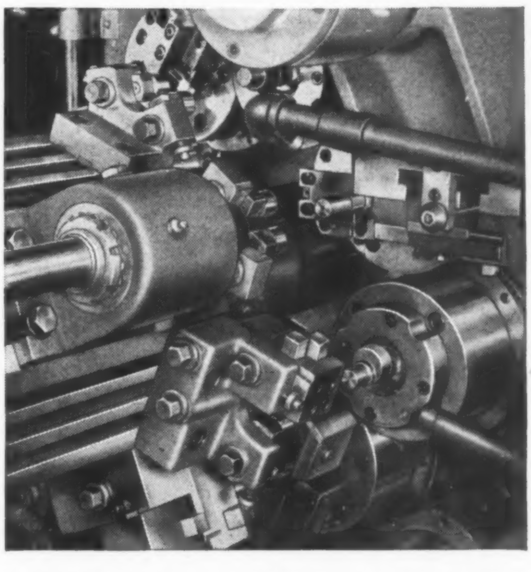


FRONT VIEW—Entirely open end construction provides accessibility for simplified chucking, cutting tool and attachment setup.

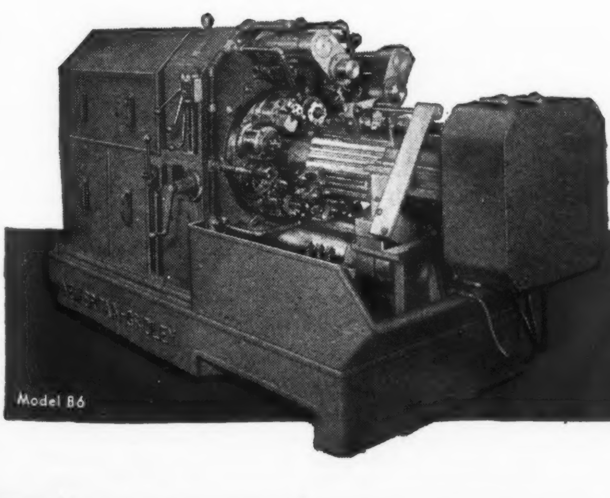
The piece shown above is a good illustration of the versatility of the New Britain Model 86 Eight Spindle Automatic Chucking Machine. By using double index on the Model 86, four spindles are used for one end of the crank shaft and the other four spindles used for the other end. Thus each time the machine indexes, it delivers a finished part.

Very important, too, is the maintenance of close diameter limits of both ends and holding the limits between the shoulders of the eccentric. This calls for a remarkable degree of precision in locating the shaft during the second operation . . . a severe test of the accuracy of the spindles and the carrier locating and locking mechanism.

Production figures prove the ability of the machine to meet these testing requirements: The fifteen necessary operations are performed in 19 seconds. The gross production is 190 pieces per hour, with accuracy maintained well within the specified tolerances. Your work may or may not be similar to this particular job. One thing is sure . . . if it involves high production, and you want low cost per piece, the New Britain representative in your locality is the man to see.



REAR VIEW—Wide open end construction provides extra large chip . . . space accessibility from three sides and from above that permits excellent visibility and easy tool adjustment.



NEW BRITAIN AUTOMATICS

THE NEW BRITAIN MACHINE COMPANY
NEW BRITAIN, CONNECTICUT
NEW BRITAIN-GRIDLEY MACHINE DIVISION

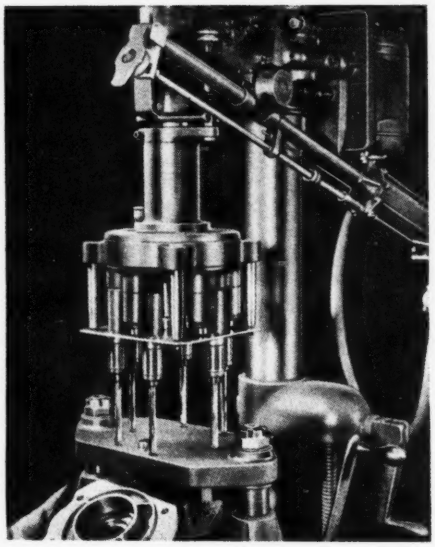
M-01043

cludes checking the pressure between spot-welding machine electrodes; pressure between platens in all types of presses; pressure between moving rollers; and tension in a moving thread, twine, wire, etc. The compact design of these gages was developed to permit them to be used in inaccessible places where pressures of static or moving parts must be measured. 81

Drill Head that Permits Infinite Range of Hole Patterns

A new multiple, adjustable drill head, manufactured by the Wisconsin Drill Head Co., Ltd., and distributed by Strutz & Mead, Inc., Milwaukee, Wis., is entirely gear-driven, and has two to six spindles, each of which revolves completely around two different centers of 15/16-inch radius. Thus, each drill point can be located and locked at any point in the area of a 3 3/4-inch circle. As each circle overlaps at least one other circle, the variety of hole patterns that can be produced is limited only by the number of spindles employed and the combined area of the various spindle circles. Another feature of this head, which is known as the "Quick Change" drill head, is the fact that a set of templets is furnished for every hole pattern or bolt circle that the user may wish to drill.

While this new head is made in standard models with from two to six spindles, all of the spindles in a particular head do not have to be used in each set-up. For example, a four-spindle head could be used for a three- or a two-hole pattern. Minimum centers are 1 1/8 inches, and maximum bolt circles are 8 3/4 inches in diameter.



Multiple Adjustable Drill Head Made by Wisconsin Drill Head Co.

The new drill head can be mounted on most standard drill presses without special tools. Adapters are furnished for standard makes of drill presses. 82

Jig for Drilling Cross-Pin Holes, and Adjustable Knurling Tool

The Becker Tool Co., 45 Twenty-second St., Irvington 11, N. J., is placing on the market an improved jig for drilling cross-pin holes in shafts and studs, and a new straddle knurling tool of unique design.

The jig, shown in Fig. 1, is an improved model of a design brought out by the Fifty Plus Machine Shop and described in February MACHINERY. It is now equipped with a quick-action work-holding clamp and an adjustable work-locating stop. The jig consists of an inverted V-block supported by four studs or columns, a crosswise clamping bar with lever-operated quick-acting clamping cam, two clamping studs, and a knurled-head slip drill bushing which is accurately positioned in the V-block above the center of the V-groove.

The work-locating stop consists of a block with adjustable stop-pin which can be clamped in any desired position on its two supporting parallel rods which project from the end of the V-block. With this jig, uniformly positioned crosswise holes can be drilled in pins, shafts, studs, etc., from 1/8 to 1 inch in diameter by setting the stop to locate the work in the correct position under the hardened drill bushing. After the clamping studs have been properly adjusted for the size of work to be drilled, simply pressing down on the clamping lever serves to hold the work securely in place.

The knurling tool, shown in Fig. 2, can be adjusted for knurling round pieces of any size from 1/4 inch to 2 1/4 inches in diameter. This tool consists essentially of a forged holder, two casehardened steel jaws carrying high-speed steel knurling rollers, a pivoting stud for clamping the jaws to the holder, and a right- and left-hand threaded screw for adjusting the jaws to suit the diameter of the work. When in use, the tool shank is clamped in the lathe tool-post. It is set for the knurling operation by simply loosening the jaw-clamping stud and adjusting the right- and left-hand threaded screw.

In performing the knurling operation, the lathe cross-slide is fed forward until the work is centered between the knurling rollers. The carriage can then be fed longitudinally to knurl the work to any length desired. A full perfect knurl or serration can be obtained in one passage of the tool. 83

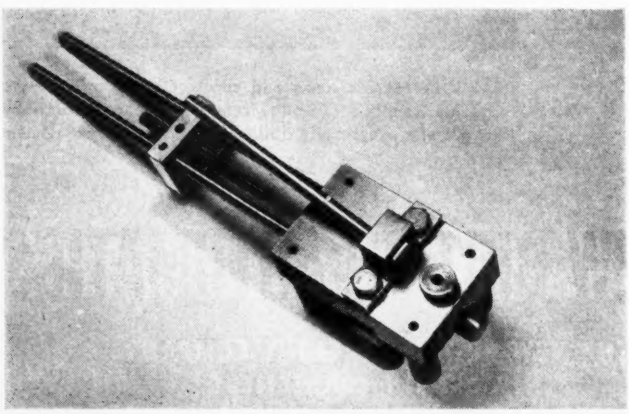


Fig. 1. Becker Improved Jig for Drilling Cross-pin Holes

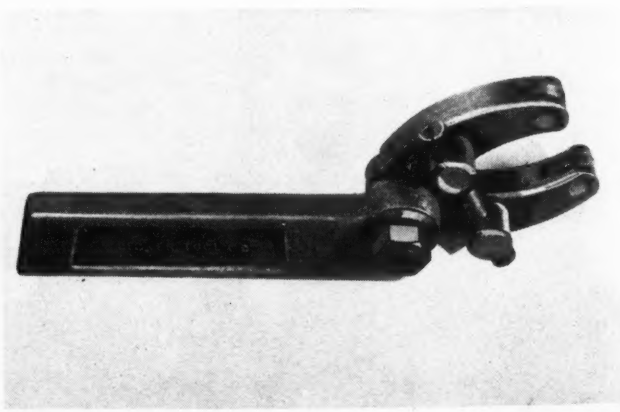
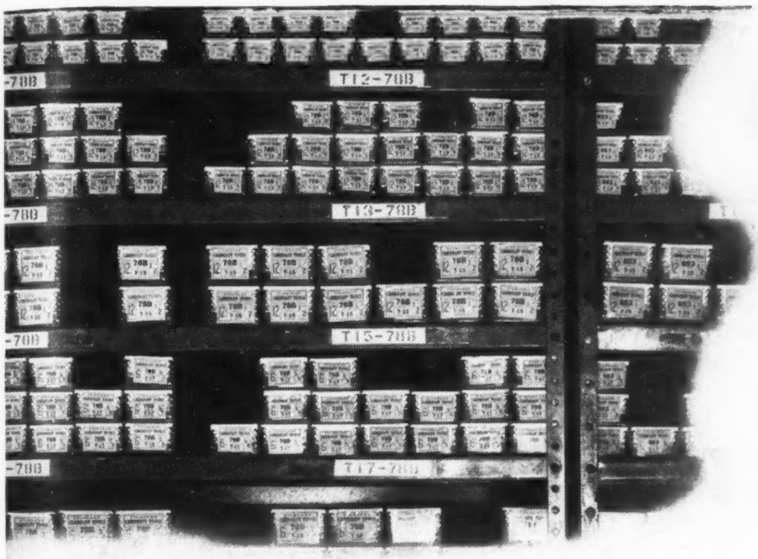
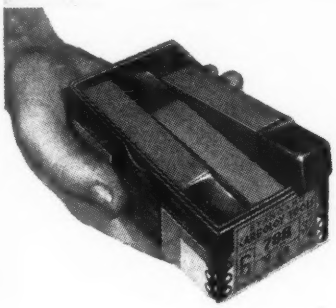


Fig. 2. Knurling Tool Brought out by the Becker Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 248.





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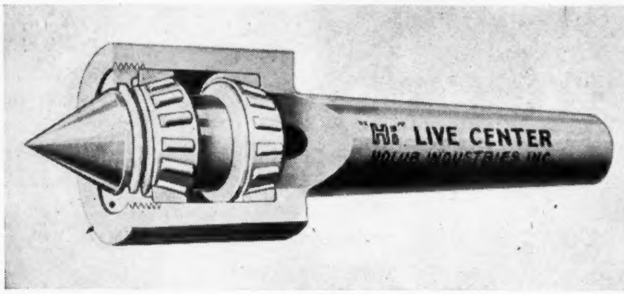


"Holub" Precision Live Center Designed to Support Heavy Loads at High Speeds

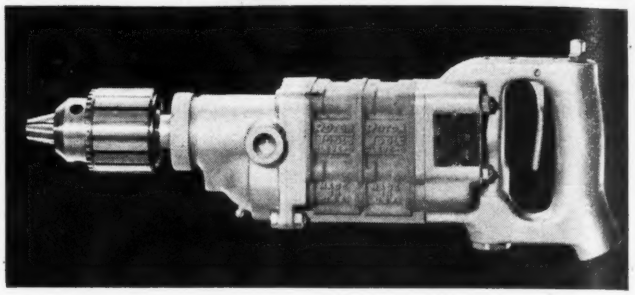


Fig. 1. Air Drill Equipped with Spade Handle, Made by the Rotor Tool Co.

Holub Live Centers

A new line of precision "Hi" live centers designed to handle heavy loads at high speeds has been brought out by Holub Industries, Inc., Sycamore, Ill. These live centers are equipped with two matched and preloaded precision Timken roller bearings. The matched roller bearings are preloaded by means of a threaded adjusting ring. This center design has been developed to assure extreme accuracy, eccentricity or run-out of the point being held to 0.0002 inch, when running free or under load.

The live centers, in addition to being capable of operating at high speeds, have load-carrying capacities up to 1000 pounds in the Nos. 2 and 3 Morse taper sizes, and up to 2400 pounds in the Nos. 4 and 5 Morse taper sizes. High resistance to shock loads is obtained by large contact surfaces of the tapered rollers on the bearing races. Another improvement is a heavy-duty grease seal, which resists wear from metal chips and prevents all foreign matter from entering the bearing. 84

Boyar-Schultz Adjustable Drill- and Reamer-Holder

An adjustable drill- and reamer-holder developed to insure the close dimensions required for interchangeability has been brought out by the Boyar-Schultz Corporation, Walnut St. at Hoyne, Chicago 12, Ill. It is made from drop-forged alloy steel, and is designed to withstand impact and strain. The hardened and ground mating surfaces, bore and shank, serve to promote quick, easy adjustments and reduce set-up time.

This holder is designed for extra strength, and has a heavy set-screw boss. It is available in three sizes—No. 00, No. 0, and No. 2. Either a long or a short shank is available in the 00 and 2 sizes. One bushing blank is furnished with each tool...85

Rotor Air Drills

The Rotor Tool Co., Cleveland, Ohio, has announced two completely new air drills of intermediate sizes which are adapted for use in assem-

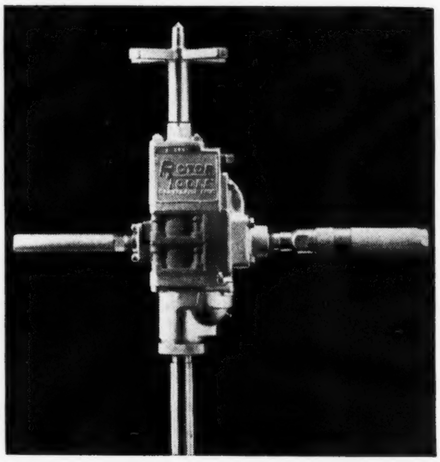


Fig. 2. Rotor Air Drill Furnished with Side Handle

bly departments and all metal-working plants. The E-22 drill, shown in Fig. 1, is provided with a spade handle and auxiliary side handle. It will drill holes up to 9/16 inch in diameter, and will set 3/8- and 1/2-inch nuts and 3/8-inch lag screws or 1/2-inch machine screws. Speeds of 625, 750, 1000, and 1200 R.P.M. are available. This drill weighs 9 pounds.

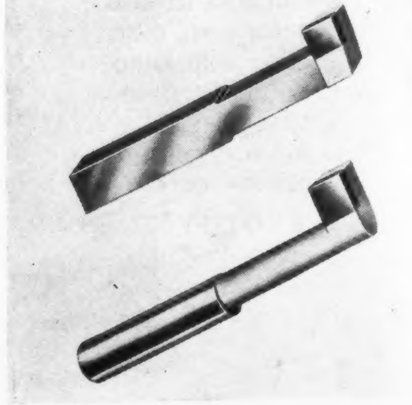
The E-42 drill, shown in Fig. 2, is furnished in side-handle style, having a live and a dead handle with feed-screw, breast plate, or suspension ring. It is available with a No. 2 Morse taper feed-screw and in both non-reversible and reversible types. It weighs 13 1/2 pounds, and will drill 9/16- and 7/8-inch holes, ream and tap 3/8- and 5/8-inch holes, and set 3/8- and 1/2-inch hexagonal-head nuts.

Both of these drills use the same external blade type motor developed by the Rotor Tool Co. Both tools are controlled by governors which limit the free running speed of drill points, for example, but provide full power at approximately 90 per cent of the free speed with cutting speeds of 70 to 100 feet per minute. Right-angle attachments are available for the E-22 drill for use in drilling, screwdriving, or nut-setting...........86

Carbide-Tipped Boring Bits

Carbide-tipped boring bits designated by the trade name "Star" are now being manufactured and sold by the Samuel S. Gelber Co., Department J, 542 W. Washington Blvd.,

Boyar-Schultz Drill- and Reamer-holder



"Star" Carbide-tipped Boring Bits

To obtain additional information on equipment described on this page, see lower part of page 248.

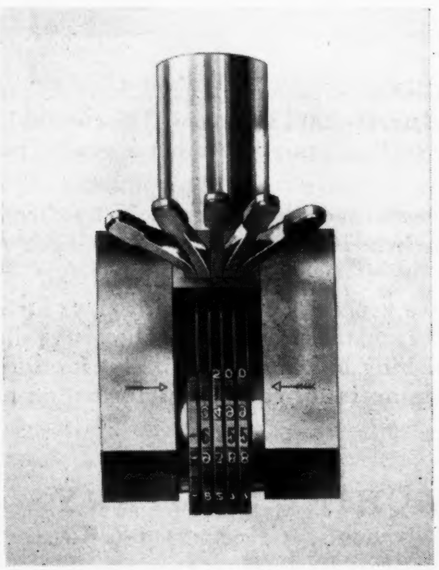
Chicago 6, Ill. These bits are made in both round- and square-shank styles and in two grades—one for cutting steel and one for general-purpose work. They are recommended for production work where a fine finish is required.

The shanks of these bits are made of heat-treated alloy steel, and have extra thickness under the carbide tip to provide ample support for heavy cutting. 87

Selective Number Stamping Head

Wm. A. Force & Co., 216 Nichols Ave., Brooklyn 8, N. Y., has brought out a new design of selective type indenting numbering head for use on metal parts or products. This head, known as Model 27, is similar in design to the standard automatic numbering head made by this company, with the exception of the action. In place of the automatic consecutive action, each wheel is provided with an individual control lever which can be operated to index any desired number into the stamping position. One number is advanced on each wheel for each depression of its respective lever, thus permitting the operator to set the head for any combination of numbers within the range of the stamp.

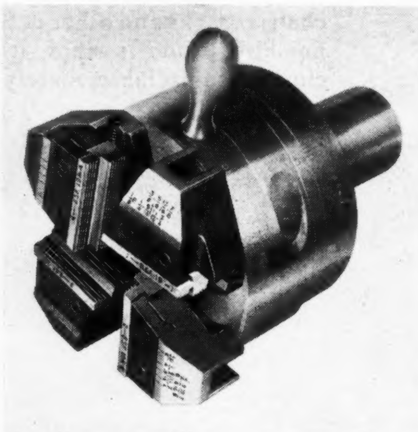
The wheels carrying the stamps are indexed for the direct reading of the number in the printing position, so that the operator can tell at a glance if the stamp is correctly set for the number desired. Although developed primarily for use on lock cores and keys, the stamp is adaptable for any small metal parts that require frequent changes. It is also available in a six-wheel capacity model with figures ranging from 1/16 to 3/32 inch in size. 88



Number Stamping Head Made by Wm. A. Force & Co.

Landis Double-Diameter Chasers

The Landis Machine Co., Waynesboro, Pa., recently developed a double-diameter, tangential type, ground-thread chaser which has all surfaces, including the thread form, ground after hardening. These chasers are guaranteed to hold threads within Class 3 fit requirements on two diameters. It is, of course, essential that the threads produced on the two diameters be of the same form and pitch.



Double-diameter Ground-thread Chaser Developed by Landis Machine Co.

There are limitations in the difference between the two diameters for which the chasers can be furnished, and each set of chasers must be designed for the threading job for which it will be used. Both threads on the work should be of a fairly short length to permit satisfactory use of the double-diameter chaser. 89

Bayflex Abrasive-Disk Wheels

The Bay State Abrasive Products Co., Westboro, Mass., has brought out a new line of raised-hub type abrasive-disk wheels, especially designed for long wear. The new wheels have a wide range of applications, especially in the field of welded or brazed metals. They are adapted for grinding aluminum castings, and are now being used to advantage for a variety of operations in foundries, sheet-metal shops, automobile and truck body repair shops, and welding shops.

Abrasive-disk Wheels Made by the Bay State Abrasive Products Co.

Among the advantages claimed for these wheels is the quality that permits their edges to be used for grinding and even cutting-off operations. The disks can be used efficiently right down to the holding nut. The wheels will fit any standard machine employing coated disks, and are available in the same grit sizes as the coated disks. 90

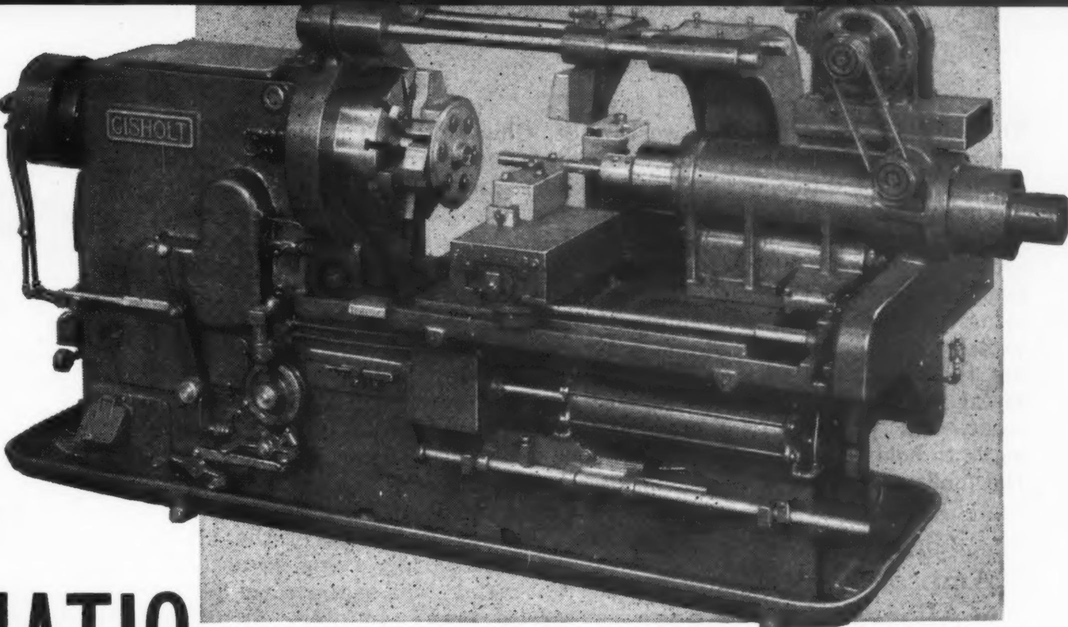
Eye and Face Protecting Shield

The American Optical Co., Southbridge, Mass., has announced a new face shield designed to give extra protection to the worker on such jobs as babbitting, handling chemicals, and certain operations performed in the manufacture of high octane gas.

Face Shield Made by the American Optical Co.

To obtain additional information on equipment described on this page, see lower part of page 248.

is standard platen type Simplimatic, specially tooled for machining rear axle drive gear hubs, in combination with standard tool slides, is equipped with motor-driven quill for rotating the boring bar. Part is completely achined with 7 rough and finish cuts in 2½ minutes, floor to floor.



THE GISHOLT SIMPLIMATIC *makes it* SIMPLE — *and* FAST!

• Here's another example of the adaptability of the Gisholt Simplimatic—a standard machine which gives you all the advantages of an automatic lathe individualized for the specific job.

This is made possible by the large horizontal platen table which permits a greater number of independent tool slides, each favorably cammed for its own particular cut, and providing an ideal condition for each tool as to cutting speed and feed, order of engagement, dwell and retract.

Rugged, fast, and accurate, the Simplimatic pays dividends in any shop, small or large, seeking maximum production at minimum cost. Ask for complete information.

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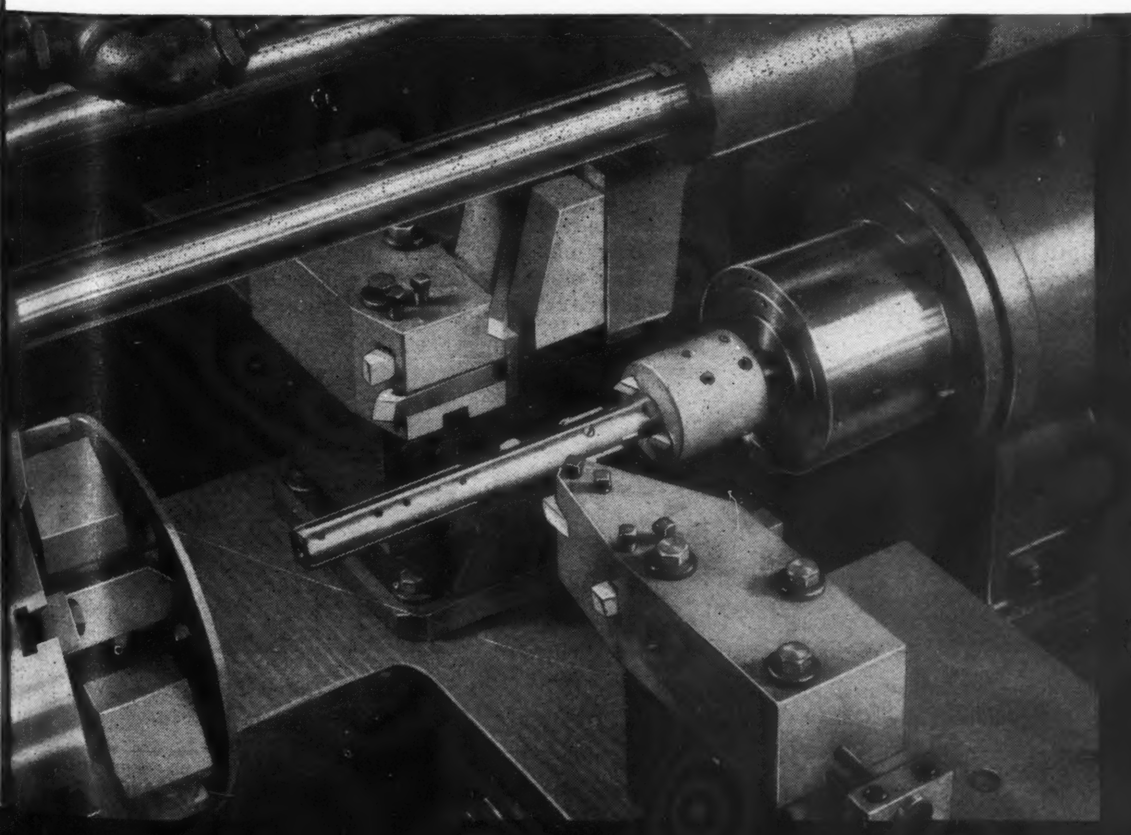

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This shield also guards the worker against flying particles, acids, oil, alkalies, or hot water.

The extra large window—18 3/4 by 10 inches—is made from cellulose acetate 0.040 inch thick. It extends completely around the face, even covering the ears. The fiber head guard protects the upper forehead and covers the entire top of the head. A metal knob permits quick adjustment, and positive friction joints serve to hold the window securely in the "on" or "off" guard position.....91

Ampco Copper-Tungsten Alloy Welding Rods

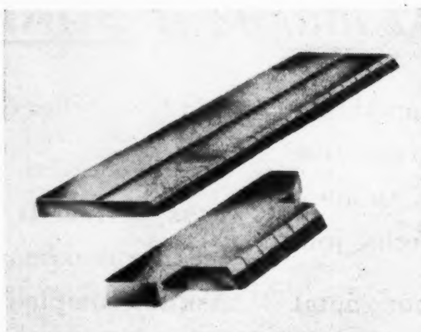
A new line of copper-tungsten alloys in the form of rods, bars, and inserts is being placed on the market by Ampco Metal, Inc., Department M-11, Milwaukee 4, Wis. These rods have been brought out to enlarge the manufacturer's line of Ampcoloy resistance-welding electrodes and to provide a suitable alloy for special conditions where the electrodes are subjected to high heat and pressures over a fairly long period or where water cooling is not always available or adequate.

The main applications of these alloys are for projection and flash welding, die facing, inserts, and electrical upsetting and forging dies. Two silver-tungsten alloys are also being produced by this company in the form of rods, bars, and inserts, which are suitable for applications such as circuit-breaker contacts and arcing tips. 92

Segment Type Work-Rest Blades for Centerless Grinders

A carbide-tipped work-rest blade of an entirely new design has been developed for centerless grinders by Scully-Jones & Co., 1901 S. Rockwell St., Chicago, Ill. The blade is of the segmented type, as shown in the illustration. Thus when one or more of the segments become damaged, it is unnecessary to scrap the entire blade, as is the case with blades tipped with a simple solid strip of carbide. In the event of damage to the new blade, it is simply returned to the factory for replacement of the damaged segment. This new design is also said to make possible the use of a harder, longer wearing grade of carbide, which gives appreciably longer runs between grindings.

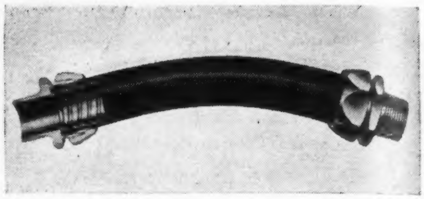
The segment slots in the blades are self-clearing, being so designed that metal chips and grit are quickly carried away by the circulating coolant, thus preventing chips from damaging the work being ground. It is claimed that the slots in these rests will not mar or score the softest work. 93



Scully-Jones Segment Type Work-rest Blades for Centerless Grinding

"Sealtite" Electrical Conduit

The Metal Hose Branch of the American Brass Co., Waterbury 88, Conn., has developed a new "Sealtite" flexible electrical conduit for covering electrical wiring on any type of machine that may come in contact with oil or moisture. This new flexible conduit has been especially developed to solve the problem of excluding moisture and oil from electrical wiring on machine tool equipment, and to meet the latest requirements of the National Machine Tool Builders' Association.



"Sealtite" Flexible Conduit for Protecting Electrical Wiring

The "Sealtite" conduit is made of galvanized-steel flexible tubing with a substantial thickness of oil-proof synthetic material. The standard pipe-thread fittings of the conduit are available in two styles—one style being permanently attached at the factory, while the other is assembled on the job. In addition to being liquid-tight and capable of being bent to very small radii, the conduit is constructed to resist abrasion and to stand up well against the ordinary abuses encountered in shop operations. It is made in all standard sizes up to and including an inside diameter of 2 inches. 94

Madison Rough-Boring Tool

A rough-boring tool designed for use on both production and jobbing-shop work has recently been added to the line of tools made by the Madison Mfg. Co., Spring and Bauer Sts., Muskegon, Mich. This tool is of the block type, similar to the Madison reaming tool. It differs from conventional types in that the cutting blades are not inserted in a block, but themselves serve to form the cutting block. Among the chief advantages claimed for this new tool are quick change of cutters; microm-

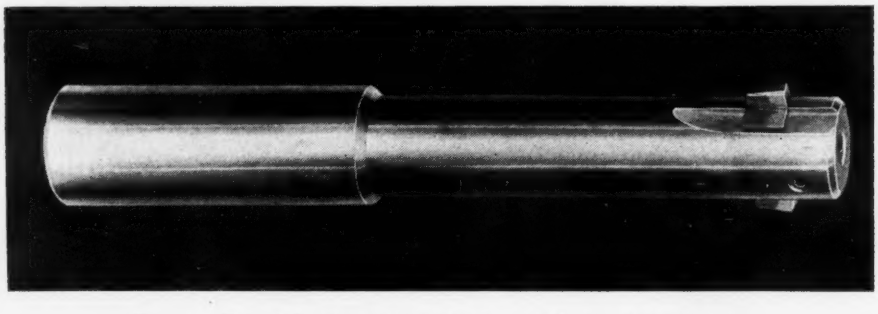


Fig. 1. Rough-boring Bar with Cutter Blades Made by the Madison Mfg. Co.

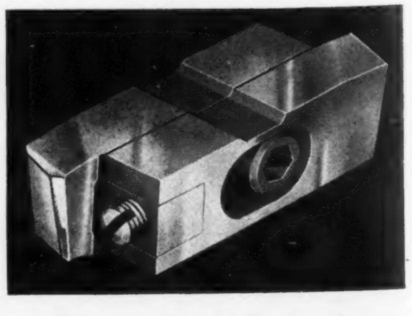
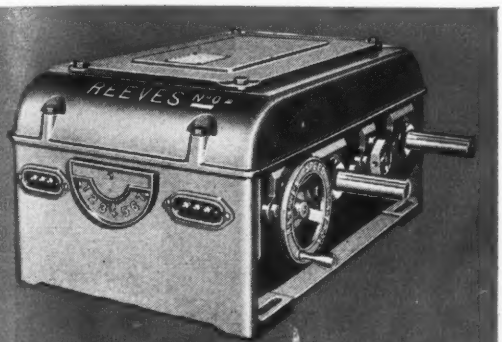


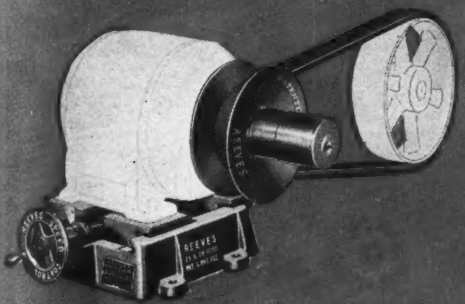
Fig. 2. Cutter Blades for Bar Shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 248.

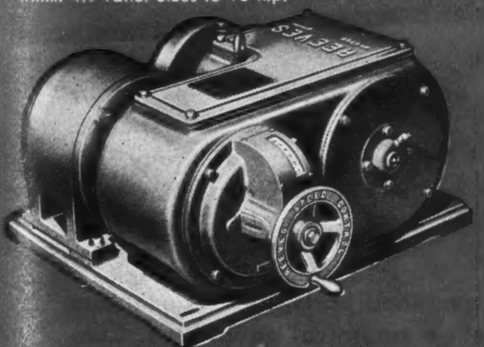
Before you select Variable Speed Equipment check these 3 points...



VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over wide range—2:1 to 16:1. Sizes fractional to 87 h.p.



VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive within 4:1 ratio. Sizes to 15 h.p.



MOTODRIVE combines motor, speed varying mechanism and reduction gears in single, compact unit. Speed variation 2:1 to 6:1 inclusive. Sizes to 15 h.p.

Before selecting the type of variable speed equipment you'll want for the machines you build or operate, first consider these three points:

1. Is the equipment easy and inexpensive to maintain and service . . . without special tools or specialized training?
2. Is the equipment dependable . . . time-tested by a wide variety of applications on production machines?
3. Does the manufacturer of the equipment provide adequate engineering and service facilities?

Here is how REEVES answers these three questions:

FIRST: REEVES Variable Speed Drives are simple in design and rugged in construction, employing a time-tested principle of V-belt driving between semi-steel discs which are adjustable to form an infinite number of diameters. REEVES Speed Control units have few moving and wearing parts . . . employ force-feed lubrication . . . need little maintenance and require no special tools or specialized training to service.

SECOND: The dependability of REEVES Variable Speed Drives has been proved by successful application on more than 260,000 REEVES-equipped machines now in operation in some 25,000 widely diversified industrial plants.

THIRD: REEVES maintains a nation-wide organization of speed control experts whose services are always available to assist you in the correct application and trouble-free operation of REEVES Variable Speed Drives.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

To assist you in determining the REEVES unit best suited to your own particular needs, you'll want the complete information contained in the 96-page catalog M-450.

Accurate Variable

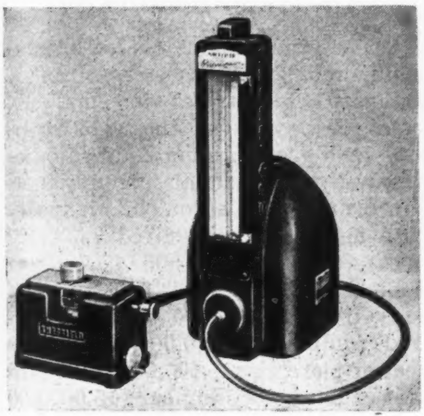
REEVES Speed Control

Gives the Right Speed for Every Job!

eter-thread screw adjustment of cutter size before mounting in the bore; and positive centering of the cutter in the bar to equalize the load on the cutting elements. This cutter can be expanded to compensate for wear and regrinding by making a simple adjustment with a screwdriver. 95

Sheffield Precisionaire Internal Measuring Machine

A new Precisionaire internal measuring instrument for the accurate checking of small rings from 5/32 to 1 inch internal diameter is announced by the Sheffield Corporation, Dayton 1, Ohio. This instrument indicates taper, bell-mouth, and out-of-round conditions. It permits inspecting the rings to a depth of 9/16 inch from each side by using the handwheel vertical adjustment of the diamond-tipped gaging arms.

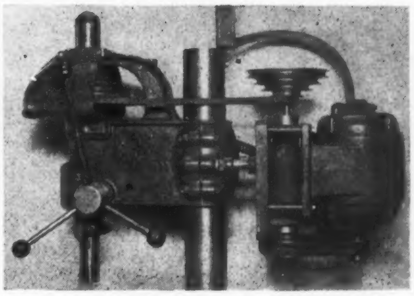


Internal Measuring Machine Made by Sheffield Corporation

Precision gage-blocks are used in setting the instrument, which is of the comparator type. Amplification is approximately 35,000 to 1. Deviations from the master setting of less than five millionths inch are easily read, as each graduated space representing five millionths inch occupies 0.175 inch on the scale. 96

Cardinal "Slo-Drive" for Drill Presses

A device known as the "Slo-Drive," which can be applied to almost any make of 18- to 20-inch drill press, is being manufactured by the Cardinal Machine Co., Glendale, Calif. This device is designed to reduce the spindle speeds to a range that will accommodate drills and other tools up to 1 inch in diameter or larger, the actual speed reduction ratio being nearly 3 to 1 below the normal range of such machines.

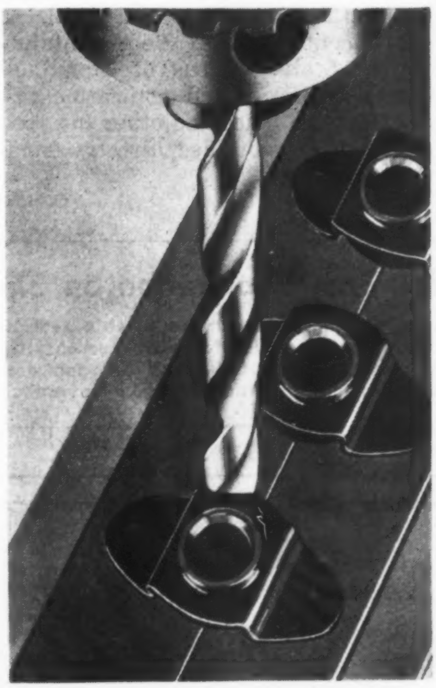


"Slo-Drive" for Drill Presses Made by Cardinal Machine Co.

The drive is a compact standardized 1-H.P. unit which will accommodate any motor. All parts required for installation are furnished. They include alloy-steel countershaft; heavy-duty steel and semi-steel two-groove drive pulleys; and precision sealed ball bearings. 97

Drill-Jig Bushing Designed for Spot-Welding to Fixture

A new type of drill-jig bushing has recently been introduced on the market by the Hi-Shear Rivet Co., 1559 Sepulveda Blvd., Hermosa Beach, Calif. Exceptionally high savings in man-hours on lofting and toolmaking time are claimed for this new product, which is called the "Anchor" bushing. It consists of a formed-steel anchor into which is pressed a hardened-steel bushing. The bushings are supplied in standard drill sizes up to 3/8 inch.



"Anchor" Bushing Placed on the Market by Hi-Shear Rivet Co.

Since the "Anchor" bushing can be quickly spot-welded to any flat or curved templet and does not require a heavy fixture, the weight of the completed tooling is said to be one-quarter or less that of ordinary drill jigs. 98

American "V-Eight" Grinding Wheel

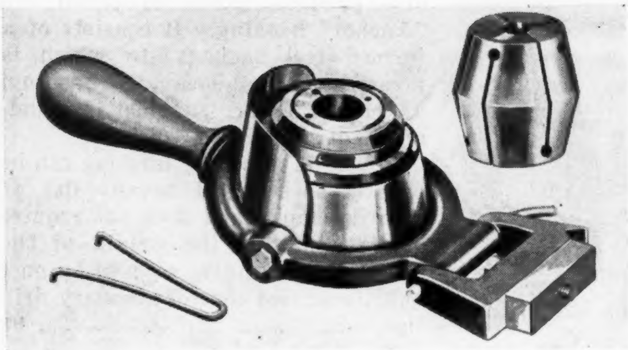
A "V-Eight" grinding wheel of entirely new design has just been announced by the American Emery Wheel Works, Providence, R. I. This wheel is similar in structure to the porous type wheels that have been widely used in recent years, but is constructed to hold its corners exceptionally well even under extremely heavy cuts. The wheel is also made in dish and cut shapes. The structure gives maximum air cooling for dry grinding, and the open cells carry extra coolant when wet grinding. This feature is claimed to enable more metal to be removed in less time and to permit the wheel face to be maintained in good cutting condition with less dressing...99

"V-Eight" Grinding Wheel Made by American Emery Wheel Works

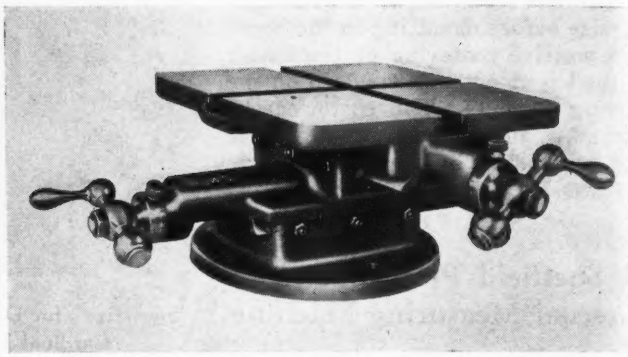
"Miracle" Collet Chuck

The Micro Parts Co., Department M, 322 1/2 E. Beach Ave., Inglewood, Calif., has brought out a new

To obtain additional information on equipment described on this page, see lower part of page 248.



"Miracle" Collet Chuck Placed on the Market by Micro Parts Co.



Two-way Sliding Table Built by the Leo G. Brown Engineering Co.

"Miracle" collet chuck which is adaptable to any standard bench lathe. It will take stock up to 1 inch in size and can be installed in a few minutes without drilling or tapping holes. The chuck extends only 1 1/2 inches beyond the spindle nose of the lathe. It can be quickly and easily changed, and when once set cannot get out of adjustment. The entire unit revolves on the spindle, thus eliminating heat and friction. Since no bearings or retainers are employed, no lubricant is required. Collets are also available for square and hexagonal bars. 100

Brown Two-Way Sliding Table for Drill Press

A small heavy-duty, two-way, precision-built sliding table with an accurately gaged travel of 5 inches in each direction, which is designed for quick mounting on any drill press, has recently been placed on the market by the Leo G. Brown Engineering Co., 1127 Riverside Drive, Los Angeles 31, Calif. This table is especially designed to reduce set-up time on small production work in metal-working, woodworking, and machine shops.

The table top is 7 1/2 inches square, and is fitted for 1-inch T-bolt heads. It is 3 3/4 inches high, and weighs only 24 pounds. 101

* * *

Industrial Trading Map

An industrial trading area map of the United States which presents in graphic form an analysis and evaluation of industrial markets has been made available by the Hagstrom Co., 20 Vesey St., New York 7, N. Y. The various areas are distinguished by different colors. These areas have been based on numerous studies and surveys of local trading and buying practices. The map gives location, size, extent, and potential of all industrial markets, large and small. A supplementary Index Book contains United States Census of Manufacturers' statistics and population index. Data on price and other information can be obtained directly from the Hagstrom Co.

Huge Requirements of the Automobile Industry

One of the reasons that the automobile industry has been so seriously hampered by strikes in suppliers' plants is because of the wide diversity and great amounts of supplies required in automobile manufacture. For example, the automobile industry in a normal year required 7,500,000 gross tons of steel; 500,000 tons of malleable iron; 1,000,000 tons of gray iron; 20,000,000 tires as original equipment; 120,000,000 square feet of plate glass; 400,000,000 board feet of hard wood lumber; 15,000,000 square feet of upholstery leather; 20,000 tons of aluminum; 150,000 tons of copper; 15,000 long tons of tin; 320,000 tons of zinc and lead; 20,000,000 pounds of nickel; 750,000 bales of cotton; 7,000,000 pounds of mohair; 500,000,000 board feet of soft wood lumber; 50,000,000 yards of cloth upholstery, and as many pounds of hair and padding; and 17,000,000 gallons of paints and lacquers. So far as the automobile industry is concerned, there is no such thing as an isolated strike.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described in this section is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in November, 1946, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

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[This service is for those in charge of shop and engineering work in **manufacturing plants.**]

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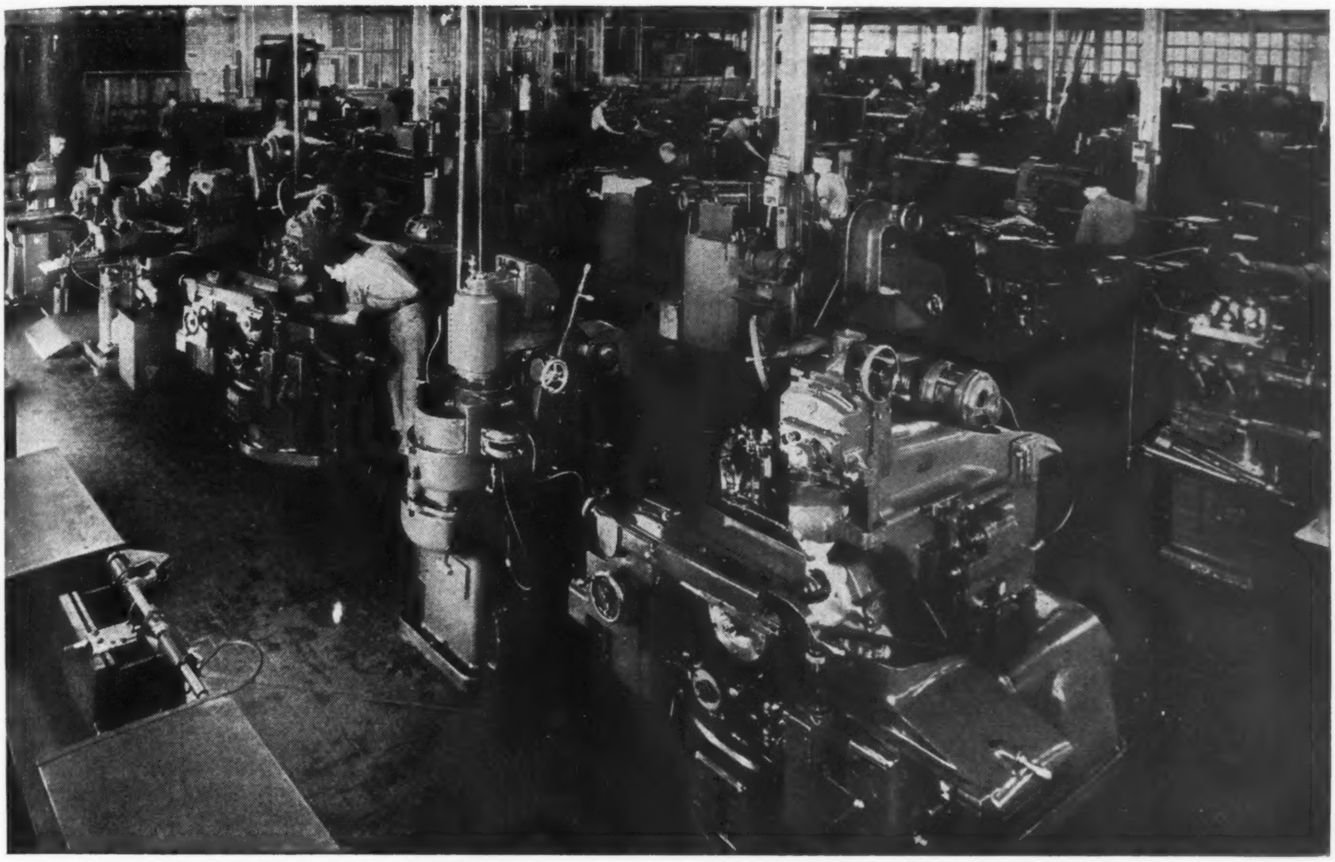
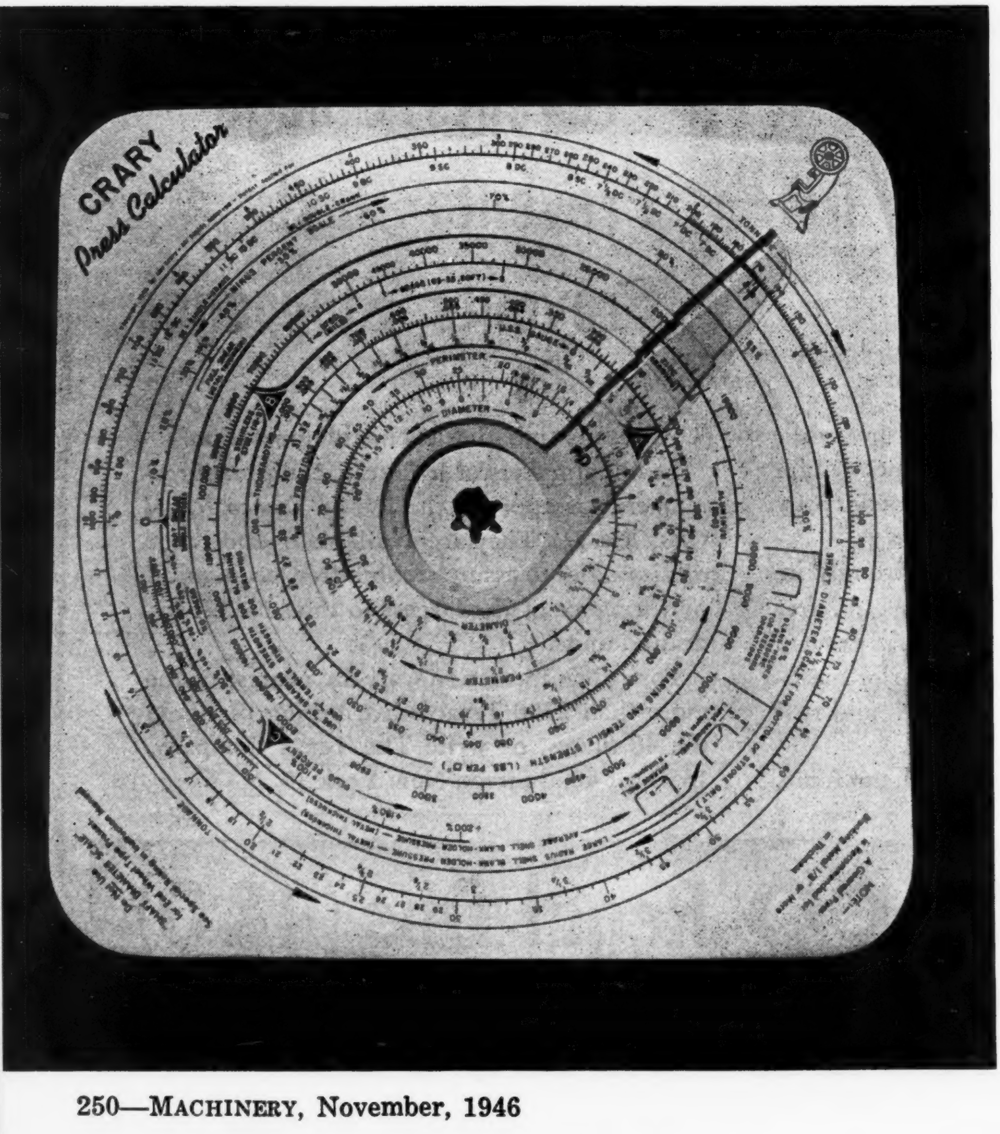


A Calculator that Simplifies Method of Selecting Presses

Selection of the correct size of press for various blanking and drawing jobs is greatly facilitated by the use of the calculator shown in the accompanying illustration. This calculator gives the crankshaft diameter and tonnage required at the bottom of the stroke for blanking jobs, and the crankshaft diameter and tonnage required away from the bottom of the stroke for drawing jobs. The correct press speed, in strokes per minute, is also given for various metals being drawn. Thickness of the material being worked can be set on one scale in either decimals or fractions. Size of blank can be set on another scale in either perimeter or diameter. Still another scale gives tensile strengths for drawing and shearing strengths for blanking common materials.

Designed by Leonard R. Crary, sales engineer of the E. W. Bliss Co., the device is being sold by the Calculator Co., P. O. Box 65, Teaneck, N. J. The calculator measures 9 1/2 inches square, and is made of non-warping Vinylite plastic with a clear sheet of plastic over the printed surfaces. It is furnished with a reference booklet and a leatherette case.

The 70-page reference booklet explains the operation of the calculator and contains a discussion of different types of blanking and drawing operations. No formulas are included, and all calculations are made automatically, directly on the calculator. Valuable tables on sheet-metal and wire gages, tonnage and press speed, average ultimate strength of materials, and approximate diameter of blanks for shells are given. Factors for different ratios of draw to blank diameter, the relationship of square to round draws, and data regarding required holder pressure for various types of drawn work are included.



The Correct Size of Press to be Used for Various Blanking and Drawing Jobs Can be Quickly and Easily Determined by Means of This Calculator

History of Machine Age Shown in Chart Form

An educational program has been undertaken by the DoAll Co., Des Plaines, Ill., designed to give a clear idea of how the so-called "machine age" has brought increasing comfort and a higher standard of living to mankind. L. A. Wilkie, chairman of the company, states that one of the principal objectives of the program is to counteract tendencies toward a decline of free enterprise. He points out that industrial management and labor must combine to protect the free enterprise system and to maintain the benefits of this expanding era of progress and potential plenty.

With these aims in view, Mr. Wilkie has prepared a wall chart entitled "History of the Machine Age" depicting an arch, the keystone of which represents machine tools as the basis of all modern industrial developments. This is supplemented by a booklet "Your Life in the Machine World" which traces the high spots of mechanical and industrial advances since early man's first use of fire and tools. Following the first section of the book, which describes the history of the use of machines in general, there is a section describing in detail the eight basic machine tools.

The chart and booklet are available without charge to industrial management and workers, school instructors, students, and all others interested. The company hopes that plant executives will cooperate in this educational program by helping to distribute the chart and booklet to industrial workers. Requests for copies should be sent to L. A. Wilkie, DoAll Co., Des Plaines, Ill.

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies Fill in on Form at Bottom of Page 255 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the November, 1946, Number of MACHINERY

Fixture Clamps

WEST POINT MFG. CO., 19625 Merriman Court, Farmington, Mich. Bulletin 15, illustrating and describing five types of Wespo fixture clamps. A book of exact-scale templet drawings for all types and sizes is available to tool designers or mechanical executives if requested on a company letter-head stating title of executive, addressed directly to the West Point Mfg. Co.

Air and Hydraulic Cylinders

MILLER MOTOR CO., 4027 N. Kedzie Ave., Chicago 18, Ill., is publishing a new house organ known as "Hyd-Air," which will be devoted to information relating to the air and hydraulic power field. Those interested can obtain copies regularly by sending their name, title, and address directly to the company.

Hydraulic Fixtures and Tooling Equipment

BARNES DRILL CO., 814 Chestnut St., Rockford, Ill. Booklet 3, covering "Barnesdril" hydraulic fixtures and tooling equipment for single-purpose, multiple, or successive drilling, reaming, tapping, boring, threading, and other operations; profusely illustrated with examples of the various units applied on a wide variety of work. 1

Carbide Tools and Blanks

VASCOLOY-RAMET CORPORATION, North Chicago, Ill. Technical catalogue VR-400, containing 32 pages of data on improved carbide tools and blanks. The information covers coolants, speeds and feeds, angles for turning tools and milling cutters, recommended thickness of tool tips, machinability ratings for various materials, and formulas for calculating horsepower requirements. 2

Production Tapping Guide

CLEVELAND TAPPING MACHINE CO., Hartville, Ohio. "Production Tapping Guide," containing information designed to assist the estimator, set-up man, and operator in employing production tapping to the best advantage. It covers tapping and spindle speeds, lubricants, tap drill sizes, allowances and tolerances for screws and nuts, production rates, etc.........3

Electric Tools and Equipment

MASTER ELECTRIC CO., 126 Davis Ave., Dayton 1, Ohio. Catalogues covering "Masterdrives" for motorizing machines; "Speedmaster" and "Cablemaster" hoists; "Big 3" electric generation for tool operation; "Power-Blow" electric hammers; portable grinders and tools; and gas-engine-driven generator plants.........4

Simplified Selection of Alloy Steels

CARPENTER STEEL CO., 105 W. Bern St., Reading, Pa. Booklet entitled "Two Steels Simplify Your Alloy Needs," describing two steels that are claimed to meet 95 per cent of the requirements of alloy steel users. 5

Temperature Control Equipment

CLAUD S. GORDON CO., 3000 S. Wallace St., Chicago 16, Ill. Bulletin descriptive of the "Xactline" straight-line temperature-control regulator, for use in tempering, drawing, quenching, and other heat-treating operations. 6

Precision Casting

KERR MFG. CO., 6081 Twelfth St., Detroit 8, Mich. Catalogue entitled "Fundamentals of Precision Casting," descriptive of the "lost wax" method. Catalogue illustrating and describing precision casting equipment and materials. 7

Worm-Gear Speed Reducers

PHILADELPHIA GEAR WORKS, INC., Erie Ave. and G St., Philadelphia 34, Pa. Bulletin 250, covering the design features of the Philadelphia "AirKooled" worm-gear speed reducers, including load capacities and horsepower ratings. 8

Oxy-Acetylene Cutting

AIR REDUCTION SALES CO., 60 E. 42nd St., New York 17, N. Y. Pamphlet entitled "Special Oxy-Acetylene Machine Cutting Applications," describing the use of the electronic tracing device made by the company. 9

Multiple Drilling and Tapping Equipment

ETTCO TOOL CO., INC., 594 Johnson Ave., Brooklyn 6, N. Y. Bulletin 31, illustrating and describing the Ettco-Emrick system and equipment for the multiple drilling and tapping of small parts. 10

Spiral-Bevel Speed Reducers

PHILADELPHIA GEAR WORKS, INC., Erie Ave. and G St., Philadelphia 34, Pa. Bulletin 200, covering design features, load characteristics, horsepower ratings, dimensions, and other data on Philadelphia spiral-bevel speed reducers. 11

Electro-Pneumatic Forging Hammers

LOBDELL CO., Wilmington 99, Del. Catalogue descriptive of the Lobdell-Nazel line of electro-pneumatic forging hammers, covering operating principle, construction, and specifications of the different types. 12

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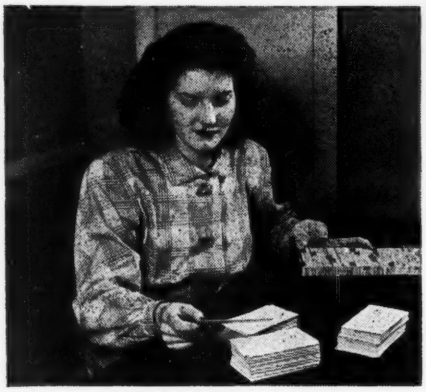

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Alundum Abrasive Wheels

NORTON CO., Worcester 6, Mass. Circular announcing the newly developed 32 alundum abrasive and examples of the performance record of grinding wheels made from this new abrasive. 13

Variable-Speed Transmission

REEVES PULLEY CO., Columbus, Ind. Circular on Reeves variable-speed control, including variable-speed transmission, "Vari-Speed Motodrive," and "Vari-Speed" motor pulley. 14

Resistance-Welding Electrodes

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee 4, Wis. Bulletin 68A, descriptive of Ampcoloy resistance-welding electrodes and alloys, including a new line of water-cooled electrode holders. 15

Rotary Files

NICHOLSON FILE CO., Providence 1, R. I. Technical bulletin R-116, entitled "Choosing and Using Rotary Files," covering high-speed steel and cemented-carbide ground burrs, as well as hand-cut rotary files...........16

Drill-Sharpening Manual

REPUBLIC DRILL & TOOL CO., 322 S. Green St., Chicago 7, Ill. Manual G-1, containing information on the correct method of sharpening twist drills to obtain best results in drilling various materials. 17

Induction Heating and Melting

AJAX ELECTROTHERMIC CORPORATION, Ajax Park, Trenton 5, N. J. Bulletin 27, describing the principles, advantages, and uses of high-frequency induction heating and melting. 18

Fatigue-Testing Machine

BALDWIN LOCOMOTIVE WORKS, Philadelphia 42, Pa. Bulletin 205, containing complete specifications on the company's Sonntag 10,000 inch-pounds rotating-beam fatigue-testing machine. 19

Controlled-Atmosphere Generator

LINDBERG ENGINEERING CO., 2458 W. Hubbard St., Chicago 12, Ill. Circular descriptive of the new Lindberg controlled-atmosphere generator for bright-hardening, sintering, and brazing. 20

Milling Machines

CINCINNATI MILLING MACHINE CO., Cincinnati 9, Ohio. Catalogue M-1506, outlining the principal features of design of Cincinnati No. 2 MI milling machines. 21

Remote Control Systems

ALLIS-CHALMERS MFG. CO., 686, Milwaukee 1, Wis. Bulletin 14B6641, descriptive of Allis-Chalmers direct-current remote indication and control systems. 22

Stainless-Steel Tubing Guide

SUMMERILL TUBING CO., Bridgeport, Montgomery County, Pa. Bulletin entitled "A Guide for the Selection of Seamless and Redrawn Welded Stainless-Steel Tubing."....23

Safety Equipment Guide

AMERICAN OPTICAL CO., Southbridge, Mass. Safety guide, classifying hazards by industries and recommending safety clothing and equipment for maximum protection.......24

Precision Gages

STURDY TOOL & GAGE CO., 14520 Schaefer Highway, Detroit 27, Mich. Catalogue on new steel, chrome-plated, tungsten-carbide, and Norbide precision gages. 25

Speed Tool Kits

STANDARD PRESSED STEEL CO., Box 22, Jenkintown, Pa. Bulletin covering the Hallowell line of speed tool kits, including socket-screw, socket-wrench, and auto key styles. 26

Protective Goggles

EASTERN EQUIPMENT CO., INC., Willow Grove, Pa. Catalogue section AWP-50, listing a new line of "Specti-Goggles" for industrial use, including prices. 27

Air and Hydraulic Devices

ANKER-HOLTH MFG. CO., 2727 Connors St., Port Huron, Mich. 64-page catalogue covering "Airgrip" chucks, cylinders, and valves. 28

Cranes

INDUSTRIAL EQUIPMENT CO., 315 N. Ada St., Chicago 7, Ill. Bulletin PG-648, illustrating and describing a portable 1-ton gantry crane......29

Friction Tap-Holder

PROCUNIER SAFETY CHUCK CO., 18 S. Clinton St., Chicago 6, Ill. Folder describing in detail the Style C friction tap-holder. 30

Sapphire Tools

ELGIN NATIONAL WATCH CO., Sapphire Products Division, Aurora, Ill. Pamphlet describing the uses of sapphire as a production tool. 31

Carbide Drills

SUPER TOOL CO., Detroit, Mich. Folder descriptive of the solid-carbide and carbide-tipped twist drills made by the company. 32

To Obtain Copies of New Trade Literature

listed in this section (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail within three months of the date of this issue (November, 1946) to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

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[This service is for those in charge of shop and engineering work in manufacturing plants.]

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Use of Tension in Sizing Operation on Seamless Pipes and Tubing

The use of tension in the final sizing operation has made possible the commercial production of small-diameter hot-rolled seamless pipe. This development was the subject of a paper recently presented in Cleveland before the annual convention of the Association of Iron and Steel Engineers by Stevenson Findlater, assistant to the president of the National Tube Co. The application of this principle not only permits substantial reductions in wall thickness of the tube to be made in the sizing mill, but also provides a means for making large reductions in the diameter of the tube with a relatively small number of roll stands.

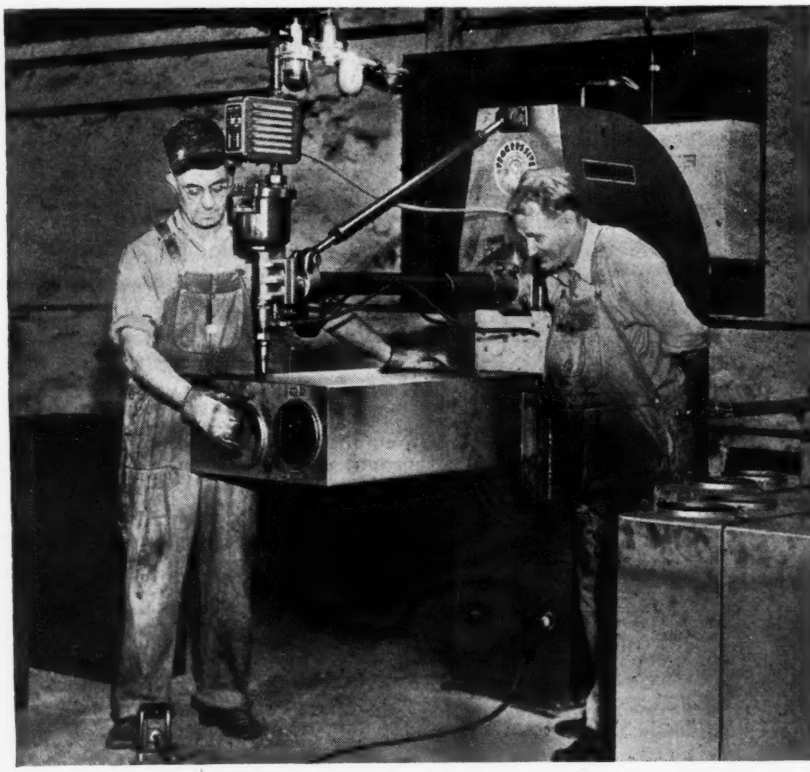
The operation involves the introduction of tension in the tube section by increasing the relative speeds of the rolls in successive stands to a greater degree than is required to compensate for the change in section area produced by the reduction in the various rolled passes. The added speed differential between the rolls in successive roll stands produces tension in that portion of the tube that is between these stands. The magnitude of this tension, which acts in the direction of the tube axis, is sufficient to elongate the tube between successive stands, thus resulting in a reduction in section area. This permits the production of finished tubes of lighter wall than the entering shell. When the wall thickness of the tube is reduced by this means, large diameter reduction can be made in roll stands without producing a non-circular inside contour.

The novel feature of the stretch-reducing process is the ability to reduce the diameter of a hot tube while simultaneously reducing its wall thickness without the use of a mandrel. The amount of wall reduction that can be effected by this method is principally controlled by the diameter of the rolls, diameter reduction per roll stand, initial wall thickness of the tube, over-all diameter reduction of the tube, and the roll speed ratios.

Single-Pedestal Welder Increases Oil-Tank Output

A reduction of 25 per cent in the over-all production time has been achieved in the manufacture of "Lubester" oil-dispensing tanks for gasoline filling stations by the Hollister Whitney Co., Quincy, Ill., through the use of a single 75-KVA pedestal welder built by the Progressive Welder Co. As a result of this reduction in production time, the company has been able to step up its output 33 per cent to meet the present heavy demand for the re-equipment of gasoline service stations.

With the welding methods formerly used, the total time per tank was approximately 2 1/2 hours. Use of the new resistance welding equipment, shown in the illustration, is said to have reduced this time by thirty-eight minutes. The machine illustrated operates on 220-volt, 60-cycle supply. It has a throat depth of 48 inches and a special rectangular arm to accommodate the shape or form of the tank being welded. The upper arm, it will be noted, is braced from the machine column, virtually eliminating any deflection in the arms during welding, despite the relatively deep throat of the machine. The operations include the welding of the top to the body of the tank and the welding of stiffening members inside the tank. The material used for the tank is 16-gage hot-rolled steel, which is not cleaned prior to welding.



Welding "Lubester" Oil-dispensing Tanks on Deep-throat Single-pedestal Welder

* * *

Blind Rivets Made from Monel

Blind rivets made from Monel metal have been added to the line of aluminum, brass, and steel rivets of this type made by the Cherry Rivet Co., 231 Winston St., Los Angeles 13, Calif. The Monel rivets are made in two standard types—self-plugging and pull-through hollow; in two standard head styles—modified brazier and 100-degree countersunk; and in diameters ranging from 1/8 to 9/32 inch.

* * *

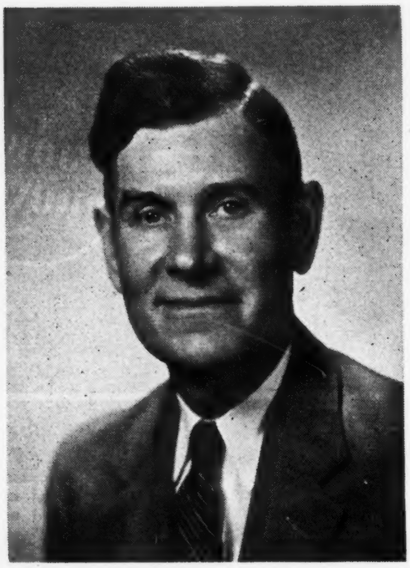
An outstanding accident prevention record has been made by the Butterfield Division of the Union Twist Drill Co. Derby Line, Vt. Since January, 1943, the company has had only twenty lost-time accidents in a period involving 2,610,000 man-hours.


JOB
PROVED

News of the Industry

California and Oregon

FREDERICK A. PURDY has been named manager of the new Los Angeles steel service plant of Joseph T. Ryerson & Son, Inc., Chicago, Ill. Warehouse operations at the new plant were begun in October. Mr. Purdy has been connected with the company since 1931. Associated with him as assistant plant manager at Los Angeles is THEODORE L. KISHBAUGH. THOMAS E. WILLIAMS has been placed in charge of the Operating and Service Divisions. He has been connected with the company for twenty-three years.



Frederick A. Purdy, Manager of New Los Angeles Plant of Joseph T. Ryerson & Son, Inc.

GEORGE W. GILLILAND, who was previously in charge of the company's Los Angeles office, will continue to serve in a sales capacity.

A. P. LERCH has been made chief tool design engineer for the Hyster Co., Portland 8, Ore., manufacturer of industrial trucks and tractor equipment.

Illinois and Indiana

WALTER W. HASKINS has been appointed manager of the Chicago branch of the L. S. Starrett Co., Athol, Mass., succeeding the late Albert W. Smith. Mr. Haskins has had wide experience in the manufacture and application of precision measuring tools, hacksaws, and band saws, having served in many capacities in the Starrett factory, and also as sales representative in the New York and Cleveland branches.

KENNETH J. MORAN and JOHN W. BEACHEM have recently joined the Canedy-Otto Co., Chicago Heights, Ill., in the capacity of sales engineers. Mr. Moran will handle the Mid-West territory, acting as district factory representative. He was formerly service engineer for the Foster Machine Co., Elkhart, Ind. Mr. Beachem will have charge of the southern territory.

CHARLES EDGAR HOYT, executive vice-president and treasurer of the American Foundrymen's Association, 222 W. Adams St., Chicago 6, Ill., has retired after thirty years of continuous service. WILLIAM W. MALONEY, who has been secretary of the Association since August, 1945, has been elected secretary-treasurer.

SKILSAW, INC., Chicago, Ill., manufacturer of portable electric tools, announces the purchase of the FORSS PNEUMATIC TOOL Co., Aurora, Ill. F. P. Forss and his son, John, who founded the company, will both remain with the Skilsaw organization, and will be in charge of pneumatic tool manufacturing operations at the Aurora plant.

J. A. HILL has been appointed manager of electric tool sales for the Independent Pneumatic Tool Co., Chicago, Ill. He was formerly manager of the New York office.

DUNCAN STUART CAMPBELL has been added to the field engineers' staff of the Illinois Tool Works, Chicago, Ill. He was previously shop superintendent of the American Gear & Mfg. Co. of Chicago.

CRUCIBLE STEEL CO. OF AMERICA, New York 17, N. Y., announces the recent opening of a warehouse and office at 4501-4531 W. Cortland St., Chicago, Ill.

B. M. LOEWENSTEIN has been appointed general sales manager of the Howard Foundry Co., 1700 N. Kostner Ave., Chicago 39, Ill.

WHEELCO INSTRUMENTS Co., Chicago, Ill., manufacturer of industrial measurement and control instruments, has opened a new district sales and service office at 107 S. Capitol Ave., Indianapolis. JOHN E. ANDERSON is in charge.

Michigan

E. A. IRWIN has been appointed general sales manager of the E. W. Bliss Co., Detroit, Mich., manufacturer of mechanical and hydraulic presses, can- and drum-making machinery, rolling mill equipment, and special machinery for pressed-metal products. Mr. Irwin has been the managing director of E. W. Bliss Co. of Canada Ltd., for the last five years, and has been associated with the company for twenty-seven years. He will be located at the company's executive offices in Detroit.

E. A. Irwin, Newly Appointed General Sales Manager of the E. W. Bliss Co.

PAUL S. STRECKER has been named director of personnel of the E. W. Bliss Co., Detroit, Mich. Mr. Strecker will direct the company's labor and industrial relations at its five plants in Brooklyn, N. Y., Toledo, Cleveland and Salem, Ohio, and Hastings, Mich.

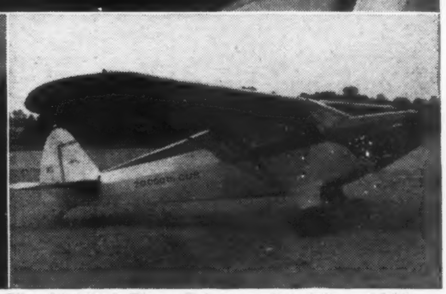
Paul S. Strecker, Recently Appointed Director of Personnel, E. W. Bliss Co.

"DRIVE TWICE AS FAST"

—Phillips Screws help Piper build 1100 Cubs a month!

20 Phillips Screws hold instruments in panel, and six more fasten panel to cowling of the Cub Super Cruiser. Before using Phillips Screws, one driver slip often required removal of all screws and scrapping or repairing damaged panel.

Fastenings near fabric covering—no place for driver slips—no slips with Phillips Screws.



The 20,000th Piper Cub, completed June 1946. Phillips Screws speeded this big production!

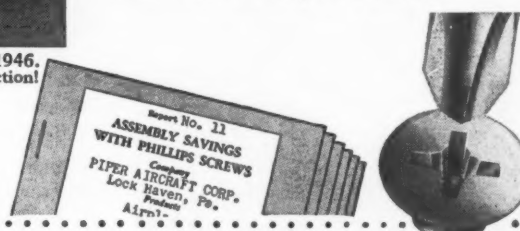
"We started using Phillips Screws back in 1938, when . . . and because . . . we were getting set for large scale production," declared Piper's Assistant Chief Inspector to the James O. Peck Co. investigator, studying assembly savings with Phillips Screws in well-known plants. "Today we're shipping our 20,000th Piper Cub. That proves how much faster Phillips Screws are to drive.

"IDEALLY SUITED TO POWER DRIVING, which we needed for high production. Unlike slotted screws, Phillips Screws hold the driver bit in place without a guide or other support, automatically center themselves in the screw holes and catch the thread quicker. Phillips Screws are easily twice as fast to drive.

"TAKES LESS TIME TO MAKE SKILLED ASSEMBLERS. It takes a man much less time to become familiar with and do a good job of driving Phillips Screws. Since the Cub is fabric covered, any driver slips would cost us expensive, undesirable patching, doping and repainting . . . up to $1.00 a slip. Same thing on the instrument panel where a single driver slip would cost up to $3.50. If we were using slotted screws, assemblers would have to go much slower, especially at the learning stage, to avoid such damage.

"WE GET A BETTER INSPECTION. Don't have to watch out for burred heads as we used to do with slotted screws. Fabric tears and instrument panel scratches are out. And the Phillips Recessed Head certainly makes a more attractive, workmanlike job wherever screw heads are exposed."

GOOD IDEAS FOR YOUR ASSEMBLY LINE in this independently made report of Piper's assembly savings with Phillips Screws. Similar studies . . . covering metal, wood and plastic products . . . available to you without cost or obligation. Use the coupon TODAY!



PHILLIPS *Recessed Head* SCREWS

Wood Screws • Machine Screws • Self-tapping Screws • Stove Bolts

26 SOURCES

American Screw Co.
Atlantic Screw Works
Atlas Bolt & Screw Co.
Central Screw Co.
Chandler Products Corp.
Continental Screw Co.
Corbin Screw Div. of American Hdwe. Corp.
The H. M. Harper Co.
International Screw Co.
Lamson & Sessions Co.
Milford Rivet and Machine Co.
National Lock Co.
National Screw & Mfg. Co.
New England Screw Co.
Parker-Kalon Corporation
Pawtucket Screw Co.
Pheoll Manufacturing Co.
Reading Screw Co.
Russell Burdsall & Ward Bolt & Nut Co.
Scovill Manufacturing Co.
Shakeproof Inc.
The Southington Hardware Mfg. Co.
The Steel Company of Canada, Ltd.
Sterling Bolt Co.
Stronghold Screw Products, Inc.
Wolverine Bolt Company

Phillips Screw Mfrs., c/o Horton-Noyes
2300 Industrial Trust Bldg., Providence, R. I. M-11

Send me reports on Assembly Savings with Phillips Screws.

Name..

Company..

Address..

....

BEN L. WISE has been appointed production engineer of the National Electric Welding Machines Co., Bay City, Mich. He was formerly assistant general manager of the Federal Machine & Welder Co., Warren, Ohio.

GEOMETRIC TOOL CO., DIVISION OF GREENFIELD TAP AND DIE CORPORATION, New Haven 15, Conn., announces the removal of its Detroit office to a new building at 2870 E. Grand Blvd., Detroit 2, Mich.

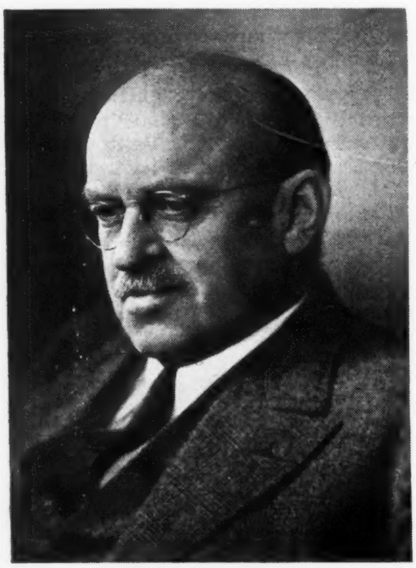
Missouri

TOOLS AND SUPPLIES, INC., 3131-3137 Olive St., St. Louis 3, Mo., has been appointed distributor for the GEOMETRIC TOOL CO., New Haven 15, Conn., manufacturer of machinery and tools for cutting screw threads.

AHLBERG BEARING CO., Chicago, Ill., has recently moved its Kansas City office into new and larger quarters at 1517 Walnut St., Kansas City, Mo. O. K. WRIGHT will continue to serve as branch manager.

New England

RALPH E. FLANDERS, president of the Jones & Lamson Machine Co., Springfield, Vt., was awarded honorary membership in the American Society of Mechanical Engineers at the fall meeting of the Society in Boston. Mr. Flanders was president of the Society in 1935, and in 1944 was awarded the Hoover Medal presented jointly by the societies of mechanical, civil, electrical, and mining and metallurgical engineers. Mr. Flanders is president of the Federal Reserve Bank of Boston and a past-president of the New England Council. As a leading authority on machine tools, he rendered valuable service to the Government during the war in an administrative capacity in that field.



Ralph E. Flanders, Who was Recently Made an Honorary Member of American Society of Mechanical Engineers

FAYETTE LEISTER has been elected vice-president in charge of engineering of the Fafnir Bearing Co., New Britain, Conn. Mr. Leister has been connected with the Fafnir organization since 1921, and has been active in the development of some of the most important anti-friction bearing improvements in the last twenty-five years, numerous patents having been issued in his name.

J. E. FIFIELD, formerly with the U. S. Naval Research Laboratory and the American Brake Shoe Co., has joined the Development and Research Division of the International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. His headquarters will be at 75 Pearl St., Hartford, Conn.

HANSON-VAN WINKLE-MUNNING CO., Matawan, N. J., has opened a new office and warehouse at 382 Seymour St., Stratford, Conn., with GEORGE G. KNECHT in charge as manager.

FEDERAL PRODUCTS CORPORATION, 1144 Eddy St., Providence, R. I., manufacturer of precision measuring instruments, has acquired the sole manufacturing rights for the Federal Metricator air gaging system, formerly manufactured at Ann Arbor, Mich. The manufacturing facilities for this equipment have now been transferred to the Federal plant at Providence. The Federal Products Corporation was previously exclusive national sales agent for this gage.

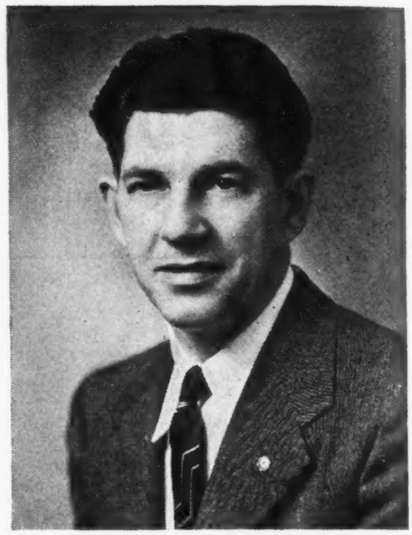
ALBERT M. STEDFAST has been elected president of Stedfast & Roulston, Inc., 156 Oliver St., Boston 10, Mass., machinery merchants. Mr. Stedfast succeeds his father, Albert R. Stedfast, who passed away several months ago.

New York and New Jersey

HARRISON WOOD has been appointed New York district manager for SKF Industries, Inc., Pittsburgh, Pa., ball and roller bearing manufacturers. Mr. Wood's headquarters will be 1976 Broadway, New York City. He succeeds JOHN D. WILLIAMSON, who resigned because of ill health after serving as head of the district for twenty-three years. Mr. Wood has been assistant district manager since 1941.

WILLIAM DEAN has been made safety director of the Morse Chain Co., Ithaca, N. Y. He was formerly safety director for the Ithaca Gun Co.

JOHN L. NEWELL has joined the C. M. Smillie Co., Detroit, Mich., manufacturer of tools, gages, fixtures, and precision screw machine products, as sales representative in the eastern territory. His headquarters will be at 2 Salem Place, Livingston, N. J.

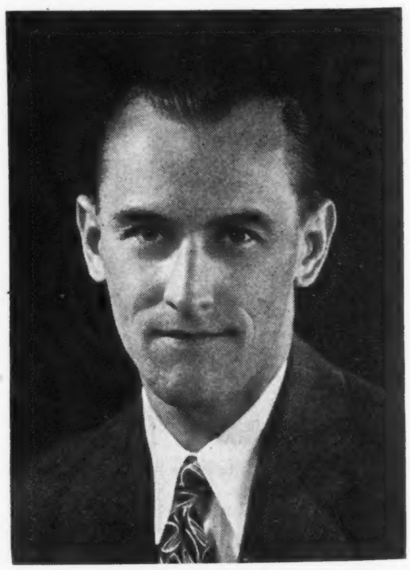


E. C. Coombs, Newly Appointed Assistant Sales Manager of the Federal Machine & Welder Co.

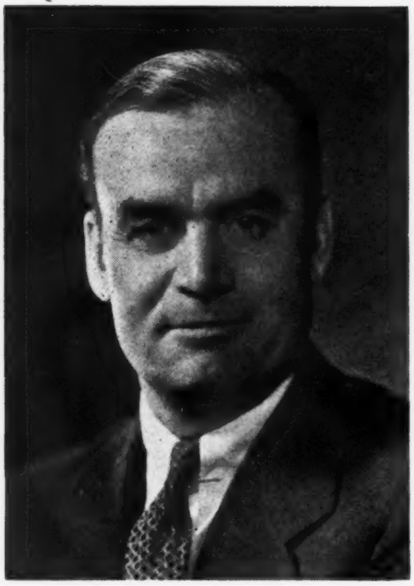
Ohio

E. C. COOMBS, formerly chief service engineer and assistant manager of sales engineering for the Federal Machine & Welder Co., Warren, Ohio, has been appointed assistant sales manager. Prior to taking charge of the Sales Engineering Division, he was head of the production planning and scheduling department of the company.

STEEL IMPROVEMENT & FORGE CO., Cleveland, Ohio, announces the establishment of a Turbine Forgings Division for the production of forgings from high-temperature alloys. CARL I. SCHWEIZER, chief metallurgist, will be in charge of the new division.



Carl I. Schweizer, Head of the New Turbine Forgings Division of Steel Improvement & Forge Co.



C. M. Taylor, Newly Elected Executive Vice-president of the Lincoln Electric Co.

Arthur Zimmerman, Recently Appointed Sales Manager of the Steel Improvement & Forge Co.

Chester H. Kimmel, Manager of the Camshaft and Crankshaft Divisions, Ohio Crankshaft Co.

C. M. Taylor has been elected executive vice-president of the Lincoln Electric Co., Cleveland, Ohio. Mr. Taylor has been connected with the company since 1916, and has been a member of the board of directors since 1927.

Independent Pneumatic Tool Co., Chicago, Ill., announces the opening of a new branch office in Cincinnati, Ohio, at 426-428 Elm St., with W. C. Rush as manager.

William J. Kerr, previously factory manager of the Yoder Co., Cleveland, Ohio, has been advanced to the position of vice-president in charge of production. Norbert C. Rubin, formerly sales manager of the company, has been named vice-president in charge of sales.

Arthur Zimmerman has been appointed sales manager of the Steel Improvement & Forge Co., Cleveland, Ohio. He was formerly associated with the Weatherhead Co., of Cleveland, as assistant chief engineer.

R. B. Tripp, vice-president of the Ohio Forge & Machine Corporation, Cleveland 4, Ohio, has been elected a director of the Reynolds Wire Co., Dixon, Ill.

Robert Potter, formerly chief engineer of the Rolling Mill Division of the E. W. Bliss Co., Salem, Ohio, has been appointed manager of the division.

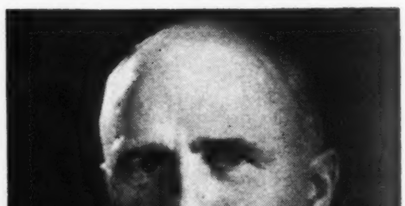
Chester H. Kimmel has recently been made manager of the Camshaft and Crankshaft Divisions of the Ohio Crankshaft Co., Cleveland, Ohio. Morgan R. Kavanagh becomes factory manager of the same divisions. Mr. Kimmel has served as factory manager of these divisions since 1940.

H. R. McLaren, formerly superintendent of tube mills for the Timken Roller Bearing Co., Canton 6, Ohio, has been made assistant general superintendent; J. P. Wargo, assistant superintendent of tube mills and finishing departments, becomes superintendent of tube mills; and R. R. Elsasser, until recently manager of the company's Newton Falls, Ohio, plant, will be assistant superintendent of tube mills.

Cleveland Automatic Machine Co., Cleveland, Ohio, announces a merger of

William J. Kerr, Vice-president in Charge of Production of the Yoder Co.

Norbert C. Rubin, Vice-president in Charge of Sales of the Yoder Co.



Morgan R. Kavanagh, Factory Manager, Camshaft and Crankshaft Divisions, Ohio Crankshaft Co.

the LeBlond Engineering Co., Cincinnati, Ohio, with the company. The business of the two concerns will be continued under the name of the Cleveland Automatic Machine Co., and the Cincinnati plant will operate as a division of that company. No changes in management, personnel, or manufacturing policies will be made.

Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, announces that the Special Products Division of the company expects soon to be in mass production on a light-weight "finger-tip controlled" garden tractor. Louis G. Albers will direct the sales program.

Asco Corporation, Cleveland, Ohio, manufacturer of the "Auto-Arb," has moved from 874 E. 140th St., Cleveland, Ohio, to a new and larger plant at 17702 Waterloo Road, Cleveland 19.

James C. Hartley has been appointed chief metallurgist of Barium Steel & Forge, Inc., Canton, Ohio. He was formerly director of research for the Heppenstall Co. in Pittsburgh.

Fred C. Ziesenheim has joined the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, in the capacity of sales manager of the Plastics and Die-Casting Machinery Divisions.

B. F. Goodrich Co., Akron, Ohio, announces the establishment of a new Plastics Production Division, with Bert S. Taylor in charge as factory manager.

Pennsylvania

Dr. Lewis Warrington Chubb, director of the Research Laboratories of the Westinghouse Electric Corporation, Pittsburgh, Pa., was recently awarded the John Fritz Medal and Certificate—the highest award in engineering — for "pioneering genius and notable achievements during a long career devoted to the scientific advancement of the production and utilization of electrical energy." The John Fritz Medal is awarded by representatives of four national engineering societies — The American Society of Mechanical Engineers, The American Society of Civil Engineers, The American Institute of Electrical Engineers, and The American Institute of Mining and Metallurgical Engineers.

Voss Machinery Co., 2882 W. Liberty Ave., Pittsburgh 16, Pa., has been appointed distributor in the Pittsburgh territory for the Stokerunit Corporation, Milwaukee, Wis., and will sell and service Simplex precision boring machines, planer type milling machines, and special high-production machines.

R. J. Leckrone has been appointed chief engineer in charge of engineering and machine sales of the Pittsburgh Steel Foundry Corporation, Glassport, Pa. Mr. Leckrone was formerly chief designing engineer of the Lewis Foundry and Machine Division of Blaw-Knox Co.

Kennametal Inc., Latrobe, Pa., announces the appointment of the following new representatives: George D. Smith and Wendell F. Grubbs for the Philadelphia office at 3701 N. Broad St., and E. C. Kelly for the Detroit office at 5531 Woodward Ave.

C. R. Dobson has been elected vice-president in charge of operation of the H. K. Porter Co., Inc., Pittsburgh 22, Pa. He was formerly chief industrial engineer of the Jones & Laughlin Steel Corporation.

Robert M. Arnold, president of the Arnold Engineering Co., Chicago, Ill., was elected a member of the board of directors of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., at a recent meeting of the board.

Heppenstall Co., Pittsburgh, Pa., has moved its Philadelphia office from the Drexel Bldg. to Room 1446, Broad St., Station Bldg., Philadelphia 3, Pa.

Harry F. Gracey has been made training director of SKF Industries Inc., Philadelphia, Pa.

Texas and Colorado

James H. Matthews & Co., Pittsburgh, Pa., manufacturers of industrial marking devices, have opened a southwestern district sales office in Dallas, Tex. Walter S. Beecher, formerly Cleveland sales representative, is district sales manager in charge of the new office. Mr. Beecher's headquarters will be 2817 Lovers Lane, University Park, Dallas 5, Tex.

Hydropress, Inc., 570 Lexington Ave., New York City, builder of hydraulic presses and rolling mills, has opened offices at 1065 Gas & Electric Bldg., Denver, Colo., with P. F. Bronckhurst in charge.

Wisconsin

R. D. Houghton has been appointed general manager of the Industrial Machinery Division of the Milwaukee Chaplet & Mfg. Co., Milwaukee, Wis. He was formerly export executive with the Chain Belt Co.

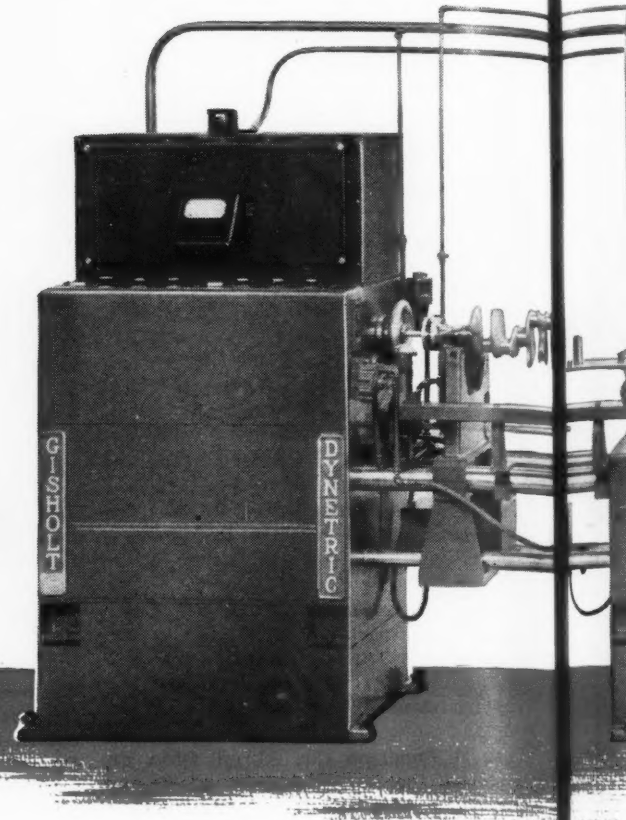
James D. Greensward has been named assistant to the vice-president of the General Machinery Division of the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

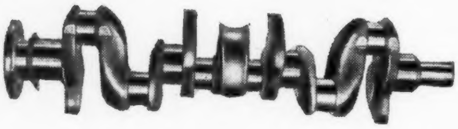
Eugene Craig Stanley, Sr., (left) who has just completed fifty years of service with the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, being presented with a fifty-year service pin by William L. Dolle, president and general manager of the company. Starting work in 1896 at the age of sixteen, Stanley's first job with the company was as an apprentice at the plant, then located at Pioneer and Culvert St. At that time the company employed less than forty people. During most of his fifty years' service, he has worked as a planer hand. Mr. Stanley is not planning to retire, but intends to keep right on working

another history-making achievement

in DYNETRIC* BALANCING

by GISHOLT

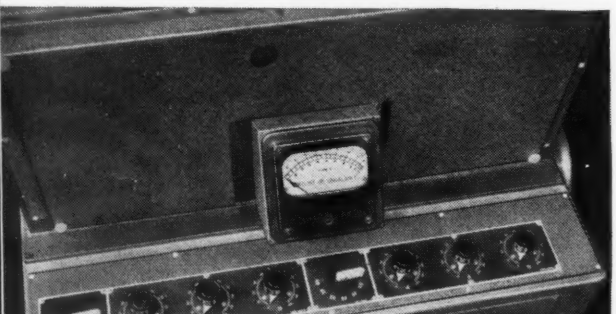




roperly defined, "balancing is a process in which ne distribution of mass in a rotor is altered to elimi- ate vibration at the bearings supporting the rotor."

Gisholt has now developed complete semi-automatic equipment to do this—*measuring and correcting unbalance* in automotive type crankshafts—with a speed and accuracy heretofore unknown.

This new Gisholt equipment, as shown above, consists of a Type C Dynetric Balancer and a correction drilling machine, electrically connected. The Dynetric Balancer indicates directly the amount of metal to be removed from specific points in the crankshaft to produce accurate static and dynamic balance. This is done by setting six dials on the balancing machine until the indicating meter reads zero. The crankshaft is then transferred by a dolly to the correction machine and positioned in a drilling fixture.



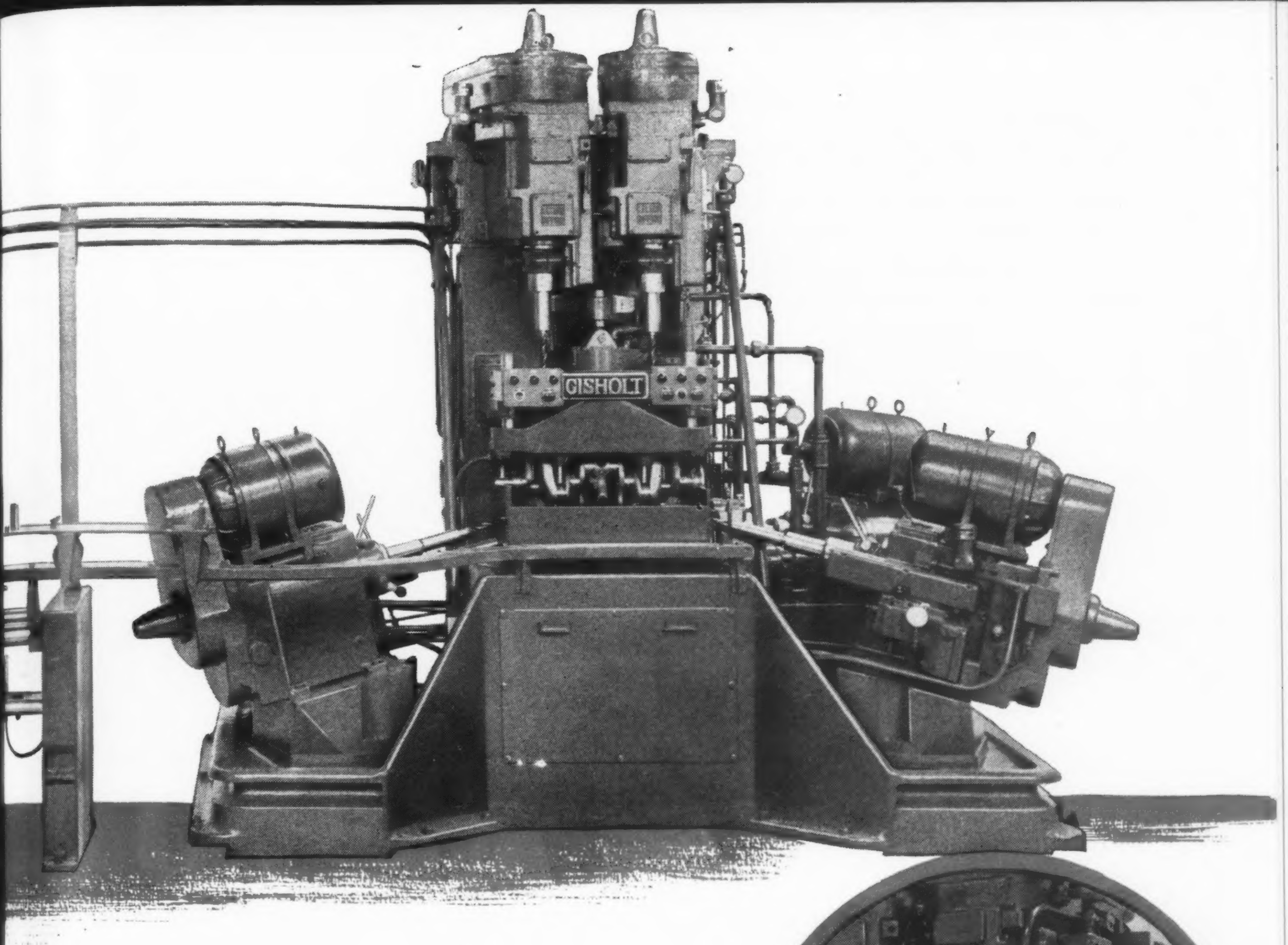
owing the control dials and meter the Gisholt Dynetric which measures unbalanced forces at each six specific points on automotive ankshafts.

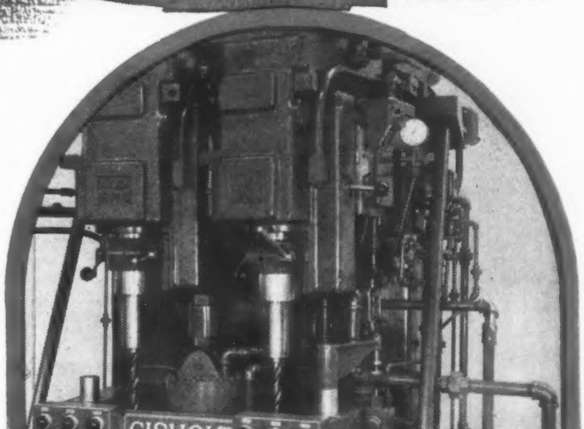
GISHOLT

Correction Information Transferred Electrically

Balancing machine indications are transmitted electrically to the six-spindle drilling machine by means of self-synchronous transmitters and receivers. The depth of each hole to be drilled is automatically set from the corresponding measurement on the balancing machine. The automatic drilling cycle, started by push buttons, includes all operations such as hydraulic clamping, starting drills and flow of coolant, initiating depth measurement of each drill separately as it contacts metal, tripping into back traverse when the measured depth is reached, and returning crankshaft to position for removal.

TURRET LATHES • AUTOMATIC LATHES •





Close-up of correction drilling machine with crankshaft hydraulically clamped in position as drills advance to six points for metal removal. When any drill becomes dull, a red light automatically warns operator and remains lit until drill point is changed.

SHELL METAL-WORKING OIL gives 25% increase in PUMP CYLINDER HONING

PROBLEM: Honing of large reciprocating pump cylinders 20 inches in diameter and 4 feet in length was "going slow" because metal particles were loading the hones . . . glazed hone surfaces produced an inferior product finish.

SOLUTION: When the Shell Lubrication Engineer surveyed the problem, he recommended the use of a Shell cutting oil, cut back for optimum flushing and cooling action. Improvement in the honing operation was immediately evident. A finer finish was produced, *and production was increased by 25 per cent.*

CONCLUSION: It pays to consult the Shell Lubrication Engineer, regardless of the nature or size of your lubricating problem. Write for informative literature on Shell Metal-Working Oils. Shell Oil Company, Incorporated, 50 W. 50th St., New York 20, New York, or 100 Bush St., San Francisco 6, Calif.

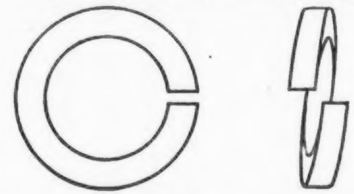
SHELL METAL-WORKING OILS

For every metal . . . for every operation

SHELL

MACHINERY'S DATA SHEETS 573 and 574

AMERICAN STANDARD SPRING LOCK-WASHERS—1



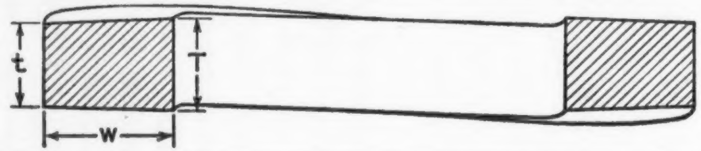
Material: Carbon Steel with a Rockwell Hardness of 47-53C

Nominal Size	Inside Diameter, Min.	Clearance of Nominal Bolt Size		Outside Diameter, Maximum (Allowances have been made for commercial tolerances on cold-drawn wire and hot-rolled rod)			
		Min.	Max.	Light	Medium	Heavy	Extra Heavy
0.086 (No. 2)	0.088	0.002	0.011	0.165	0.175	0.185	0.211
0.099 (No. 3)	0.102	0.002	0.011	0.188	0.198	0.212	0.242
0.112 (No. 4)	0.115	0.003	0.012	0.202	0.212	0.226	0.256
0.125 (No. 5)	0.128	0.003	0.012	0.225	0.239	0.255	0.303
0.138 (No. 6)	0.141	0.003	0.013	0.237	0.251	0.267	0.315
0.164 (No. 8)	0.168	0.004	0.014	0.280	0.296	0.310	0.378
0.190 (No. 10)	0.194	0.004	0.015	0.323	0.337	0.353	0.437
0.216 (No. 12)	0.221	0.005	0.016	0.364	0.380	0.394	0.500
1/4	0.255	0.005	0.017	0.489	0.493	0.495	0.539
5/16	0.319	0.006	0.020	0.575	0.591	0.601	0.627
3/8	0.382	0.007	0.023	0.678	0.688	0.696	0.746
7/16	0.446	0.008	0.026	0.780	0.784	0.792	0.844
1/2	0.509	0.009	0.029	0.877	0.879	0.889	0.945
9/16	0.573	0.010	0.032	0.975	0.979	0.989	1.049
5/8	0.636	0.011	0.035	1.082	1.086	1.100	1.164
11/16	0.700	0.012	0.038	1.178	1.184	1.200	1.266
3/4	0.763	0.013	0.041	1.277	1.279	1.299	1.369
13/16	0.827	0.014	0.044	1.375	1.377	1.401	1.473
7/8	0.890	0.015	0.047	1.470	1.474	1.504	1.586
15/16	0.954	0.016	0.050	1.562	1.570	1.604	1.698
1	1.017	0.017	0.053	1.656	1.672	1.716	1.810
1 1/16	1.081	0.018	0.056	1.746	1.768	1.820	1.922
1 1/8	1.144	0.019	0.059	1.837	1.865	1.921	2.031
1 3/16	1.208	0.020	0.062	1.923	1.963	2.021	2.137
1 1/4	1.271	0.021	0.065	2.012	2.058	2.126	2.244
1 5/16	1.335	0.022	0.068	2.098	2.156	2.226	2.350
1 3/8	1.398	0.023	0.071	2.183	2.253	2.325	2.453
1 7/16	1.462	0.024	0.074	2.269	2.349	2.421	2.555
1 1/2	1.525	0.025	0.077	2.352	2.446	2.518	2.654

Note: Washers are specified by nominal size and series; for example: 1/4 inch light, 1/4 inch medium, 1/4 inch heavy, or 1/4 inch extra heavy.

MACHINERY'S Data Sheet 573, November, 1946 Compiled by American Standards Association

AMERICAN STANDARD SPRING LOCK-WASHERS—2



Nominal Size	Washer Sections (Minimum)*							
	Light		Medium		Heavy		Extra Heavy	
	Width w	Nominal Mean Thickness $\frac{T+t}{2}$	Width w	Nominal Mean Thickness $\frac{T+t}{2}$	Width w	Nominal Mean Thickness $\frac{T+t}{2}$	Width w	Nominal Mean Thickness $\frac{T+t}{2}$
0.086 (No. 2)	0.030	0.015	0.035	0.020	0.040	0.025	0.053	0.027
0.099 (No. 3)	0.035	0.020	0.040	0.025	0.047	0.031	0.062	0.034
0.112 (No. 4)	0.035	0.020	0.040	0.025	0.047	0.031	0.062	0.034
0.125 (No. 5)	0.040	0.025	0.047	0.031	0.055	0.040	0.079	0.045
0.138 (No. 6)	0.040	0.025	0.047	0.031	0.055	0.040	0.079	0.045
0.164 (No. 8)	0.047	0.031	0.055	0.040	0.062	0.047	0.096	0.057
0.190 (No. 10)	0.055	0.040	0.062	0.047	0.070	0.056	0.112	0.068
0.216 (No. 12)	0.062	0.047	0.070	0.056	0.077	0.063	0.130	0.080
1/4	0.107	0.047	0.109	0.062	0.110	0.077	0.132	0.084
5/16	0.117	0.056	0.125	0.078	0.130	0.097	0.143	0.108
3/8	0.136	0.070	0.141	0.094	0.145	0.115	0.170	0.123
7/16	0.154	0.085	0.156	0.109	0.160	0.133	0.186	0.143
1/2	0.170	0.099	0.171	0.125	0.176	0.151	0.204	0.162
9/16	0.186	0.113	0.188	0.141	0.193	0.170	0.223	0.182
5/8	0.201	0.126	0.203	0.156	0.210	0.189	0.242	0.202
11/16	0.216	0.138	0.219	0.172	0.227	0.207	0.260	0.221
3/4	0.233	0.153	0.234	0.188	0.244	0.226	0.279	0.241
13/16	0.249	0.168	0.250	0.203	0.262	0.246	0.298	0.261
7/8	0.264	0.179	0.266	0.219	0.281	0.266	0.322	0.285
15/16	0.277	0.191	0.281	0.234	0.298	0.284	0.345	0.308
1	0.289	0.202	0.297	0.250	0.319	0.306	0.366	0.330
1 1/16	0.301	0.213	0.312	0.266	0.338	0.326	0.389	0.352
1 1/8	0.314	0.224	0.328	0.281	0.356	0.345	0.411	0.375
1 3/16	0.324	0.234	0.344	0.297	0.373	0.364	0.431	0.396
1 1/4	0.336	0.244	0.359	0.312	0.393	0.384	0.452	0.417
1 5/16	0.346	0.254	0.375	0.328	0.410	0.403	0.472	0.438
1 3/8	0.356	0.264	0.391	0.344	0.427	0.422	0.491	0.458
1 7/16	0.366	0.273	0.406	0.359	0.442	0.440	0.509	0.478
1 1/2	0.375	0.282	0.422	0.375	0.458	0.458	0.526	0.496

*Washer sections are slightly trapezoidal in shape, with the thickness at the inner periphery greater than the thickness at the outer periphery by an amount varying from a minimum of 0.0005 inch to a maximum of 0.001 inch per 1/64 inch of section width.

MACHINERY'S Data Sheet 574, November, 1946 Compiled by American Standards Association

New Books and Publications

ELECTRIC MACHINERY. By Michael Liwschitz-Garik, assisted by Clyde C. Whipple. Published in two volumes, 6 by 9 inches (Volume 1, 290 pages; Volume 2, 576 pages). Published by the D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 7, N. Y. Price, Vol. 1, $4; Vol. 2, $6.50.

This is a comprehensive work on electric machinery brought out especially for use in undergraduate courses in electrical engineering. Although written primarily for students, it also contains considerable material of value to practicing engineers. It is published in two volumes, the first of which deals with fundamentals and direct-current machines, and the second with alternating-current machines. The aim has been to demonstrate the fundamental link between the basic laws of electrodynamics and the performance characteristics of electric machines. With this end in view, the machines are treated from a general point of view and the features common to all of them are discussed in separate chapters. Among the subjects covered in Volume 1 are magnetic circuit of the main flux; magnetic circuits of the leakage fluxes; losses and cooling; armature and field windings; construction and operation of direct-current machines; and starting of direct-current motors. The volume on alternating-current machines deals with the transformer; mechanical elements and windings of alternating-current machines; polyphase and single-phase induction motors; synchronous machines; rotary converters; alternating-current commutator motor; motor application; and the starting and protection of alternating-current motors.

THE INDUSTRY-ORDNANCE TEAM. By Lieutenant General Levin H. Campbell, Jr., Chief of Ordnance, U. S. Army. 461 pages, 6 by 9 inches. Published by Whittlesey House, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $5.

The amazing joint achievement of American industry and the Army Ordnance Department in producing and delivering fighting equipment to our armed forces and to those of our Allies is related in this book. The industrial accomplishment here described has never before been equalled in the history of the world. The author, as chief of the ordnance program in World War II, directed the design, production, storage, packaging, shipment, and maintenance of more than 2000 major pieces of fighting equipment and 700,000 different kinds of spare parts designed to keep the equipment in first-class combat condition. There is no one, therefore, in a better position to record the American achievement. Facts and figures are given, and many illustrations and charts are included.

METALLURGY. By Carl G. Johnson. 418 pages, 5 1/2 by 8 1/2 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago 37, Ill. Price, $5.

The fundamentals of metallurgy of interest to those concerned with the design, shaping, sizing, or fabrication of metal products are discussed in this book. This is the third edition of the book, and contains a considerable amount of new material, including information on bearing alloys, aluminum alloys, alloy steels, copper and copper alloys, cast iron, and heat-treatment. One of the features of this work is a glossary giving the most commonly used terms employed in the working, treating, and testing of metals and alloys. It should be pointed out that the text has been planned to serve merely as an introduction to the science of metallurgy, no attempt having been made to present a complete discussion of the many phases of the science.

BEST'S SAFETY DIRECTORY (1946-1947). 351 pages, 8 by 11 inches. Published by the Alfred M. Best Co., 75 Fulton St., New York 7, N. Y. Price, $5.

This is a complete reference volume covering all types of safety products. It includes information on more than 1000 products, devices, and equipment used in connection with safety, first-aid, hygiene, health conservation, and fire protection. Besides describing the various types of safety devices and their use, the book gives the names and addresses of manufacturers, distributors, and local dealers. It should be of use to managers, safety directors, purchasing agents, plant superintendents, and industrial medical personnel.

PRACTICAL DESIGNS FOR DRILLING, MILLING, AND TAPPING TOOLS. By C. W. Hinman. 416 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $4.50.

This is the second edition of a manual that demonstrates the best methods for designing, drafting, and using drill jigs, gages, hand tools, and tapping and milling fixtures. Attention is directed to the fundamental principles on which all tools must be designed. Detailed operational functions of tools, mathematical formulas, tool engineering tables, etc., are included. A chapter on special and standard machine operations illustrates some of the progress that has been made during the war period.

MACHINING ALUMINUM ALLOYS. 124 pages, 6 by 9 inches. Distributed by the Reynolds Metals Co. (Department 47), 2500 S. Third St., Louisville 1, Ky. Price, $1.

This little manual has been prepared in answer to requests for recommendations on machining aluminum alloys. An outstanding feature is a section containing eight charts which make available in compact form recommendations covering eight of the most important machining operations. The data includes tool material and design, as well as speeds and feeds for each operation. There is also information on lubricants, coolants, and cutting compounds.

OPEN-END AND BOX WRENCHES. Simplified Practice Recommendation of the National Bureau of Standards No. R220-46. 13 pages, 6 by 9 inches. Obtainable from the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C. Price, 5 cents.

STANDARD CODE FOR ARC AND GAS WELDING IN BUILDING CONSTRUCTION. 68 pages, 6 by 9 inches. Published by the American Welding Society, 33 W. 39th St., New York 18, N. Y. Price, 50 cents.

* * *

Motion Picture on Design for Arc-Welded Structures

Simplified design, freedom in planning, the use of less material without sacrificing strength, and easier fabrication and erection resulting from the use of arc-welding in structural engineering are demonstrated in a motion picture produced by the Lincoln Electric Co. entitled "Design for Arc-Welded Structures." This film was produced to assist architects, engineers, contractors, and others in the structural field to visualize the improvements in design and construction made possible by the use of the arc-welding process. The film, which runs for approximately fifteen minutes, is available in 16-millimeter sound-color prints from the Lincoln Electric Co., 12,818 Coit Road, Cleveland 1, Ohio.

* * *

Newly Elected Officers of the Instrument Society of America

The first National Instrumentation Conference and Exhibit, held in Pittsburgh from September 16 to 20, was attended by approximately 4000 persons. At this conference, the Instrument Society of America installed the following new officers: President, C. O. Fairchild, consulting physicist; first vice-president, Carl Kayan, professor of mechanical engineering, Columbia University; vice-presidents, H. Barnum, sales consultant, J. B. McMahon, engineer with the Republic Flow Meters Co. and Ralph Munch, research chemist with the Monsanto Chemical Co.; treasurer, Hugh Ferguson, superintendent of testing of People's Gas Light and Coke Co.; and executive secretary, Richard Rimbach, president, Instruments Publishing Co.

Obituaries

Robert S. Drummond

Robert S. Drummond, who founded the National Broach & Machine Co., Detroit, Mich., seventeen years ago, died on October 9 at the Ford Hospital in Detroit after a two months' illness. He was president and director of the company until his death.

For the last two decades, Mr. Drummond had been recognized internationally as one of the foremost authorities on gear practice, especially on gear finishing. He was well known by the engineering fraternity as a speaker and writer, having several books and innumerable papers to his credit.

Mr. Drummond was born in Philadelphia on September 30, 1884, and graduated from Lehigh University as an engineer in the class of 1906. After graduation, he was connected with the Williams & White Co., of Moline, Ill., for a period of three years, and then went to Detroit. For ten years he was in charge of manufacturing and sales for the Gear Grinding Machine Co., of Detroit, and then became general manager of the Detroit Steel Products Co., of which he was also a member of the board of directors.

Mr. Drummond was a member of the Society of Automotive Engineers.

Fred S. Weatherby

Fred S. Weatherby, New England manager for the *American Machinist* and *Product Engineering*, died suddenly of a heart attack in New York City on October 3, aged sixty-nine years. Mr. Weatherby had been a member of the advertising sales staff of the *American Machinist* for almost forty-six years. At the age of eighteen, he became advertising manager of J. A. Fay & Egan Co., Cincinnati, Ohio, which position he held for three years. Shortly after leaving that concern, he joined the *American Machinist*. When a Boston office was established by the McGraw-Hill Publishing Co. in 1929, Mr. Weatherby was made New England manager. He is survived by his wife and three children.

Fred S. Weatherby

Coming Events

NOVEMBER 7-8—Tenth annual NATIONAL TIME AND MOTION STUDY CLINIC sponsored by the Industrial Management Society, at the Continental Hotel, Chicago, Ill.; the theme will be "Productivity Creates Wages." For further information, address the Society at 176 W. Adams St., Chicago 3, Ill.

NOVEMBER 7-8 — National Fuels and Lubricants Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Mayo Hotel, Tulsa, Okla. Secretary and general manager, John A. C. Warner, 29 W. 39th St., New York 18, N. Y.

NOVEMBER 17-22 — Annual meeting of the AMERICAN WELDING SOCIETY at the Hotel Ambassador, Atlantic City, N. J., in conjunction with the National Metal Congress and Exposition. Secretary, M. M. Kelly, 33 W. 39th St., New York 18, N. Y.

NOVEMBER 18-22 — NATIONAL METAL CONGRESS AND EXPOSITION in Atlantic City, N. J., under the auspices of the American Society for Metals. For further information, address managing director, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

DECEMBER 2-4—National Air Transport Engineering Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Edgewater Beach Hotel, Chicago, Ill. Secretary and general manager, John A. C. Warner, 29 W. 39th St., New York 18, N. Y.

DECEMBER 2-6—Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in New York City. Clarence E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

DECEMBER 2-7—SEVENTEENTH NATIONAL POWER SHOW at Grand Central Palace, New York. Further information can be obtained from the manager, Charles F. Roth, Grand Central Palace, New York 17, N. Y.

DECEMBER 9-11—Annual meeting of the SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS at the Hotel New Yorker, New York, N. Y. For further information, address the Society at P. O. Box 168, Cambridge 39, Mass.

JANUARY 14-17, 1947—NATIONAL MATERIALS-HANDLING EXPOSITION at the Public Auditorium, Cleveland, Ohio. Chairman of exposition committee, Edwin J. Heimer, president of Barrett-Cravens Co., Chicago, Ill.

JANUARY 23-26, 1947 — Second conference and exhibit of the LOW-PRESSURE DIVISION OF THE SOCIETY OF THE PLASTICS INDUSTRY, INC., at the Edgewater Beach Hotel, Chicago, Ill. For further information, address the Society of the Plastics Industry, Inc., 295 Madison Ave., New York 17, N. Y.

FEBRUARY 24-28, 1947—Spring meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Benjamin Franklin Hotel, Philadelphia, Pa. Secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

MARCH 17-19, 1947—CHICAGO PRODUCTION SHOW AND CONFERENCE in the Exhibition Hall of the Stevens Hotel, Chicago, Ill., under the auspices of the Chicago Technical Societies Council, 53 W. Jackson Blvd., Chicago 4, Ill.

APRIL 29 - MAY 1, 1947—INDUSTRIAL PACKAGING AND MATERIALS HANDLING EXPOSITION at Hotel Sherman, Chicago, Ill., sponsored by the Industrial Packaging Engineers' Association of America, 134 S. La Salle St., Chicago 3, Ill.

MAY 5-11, 1947 — NATIONAL PLASTICS EXPOSITION at the Coliseum, Chicago, Ill., under the auspices of the Society of the Plastics Industry, Inc., 295 Madison Ave., New York 17, N. Y.

JUNE 16-20, 1947—Annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

* * *

New DoAll Instruction Program

Volume I of "Instruction Programs" covering the technique of contour sawing is now being distributed by the DoAll Co., Minneapolis, Minn. Primarily intended for use in educational and vocational institutions, this book should also be useful to companies in instructing new employes. The material covers contour sawing and filing in all its aspects—applications, operational techniques, etc. The book is divided into two sections, one covering conventional and the other high-speed sawing procedures, including work projects and tests to be given trainees, as well as grading data. Further information can be obtained from the DoAll Co., 1301 Washington Ave., S., Minneapolis 4, Minn.

* * *

Although the civilian labor force increased by 5650 in the first post-war year, the number of women workers decreased by 2,160,000, according to the Women's Bureau, United States Department of Labor.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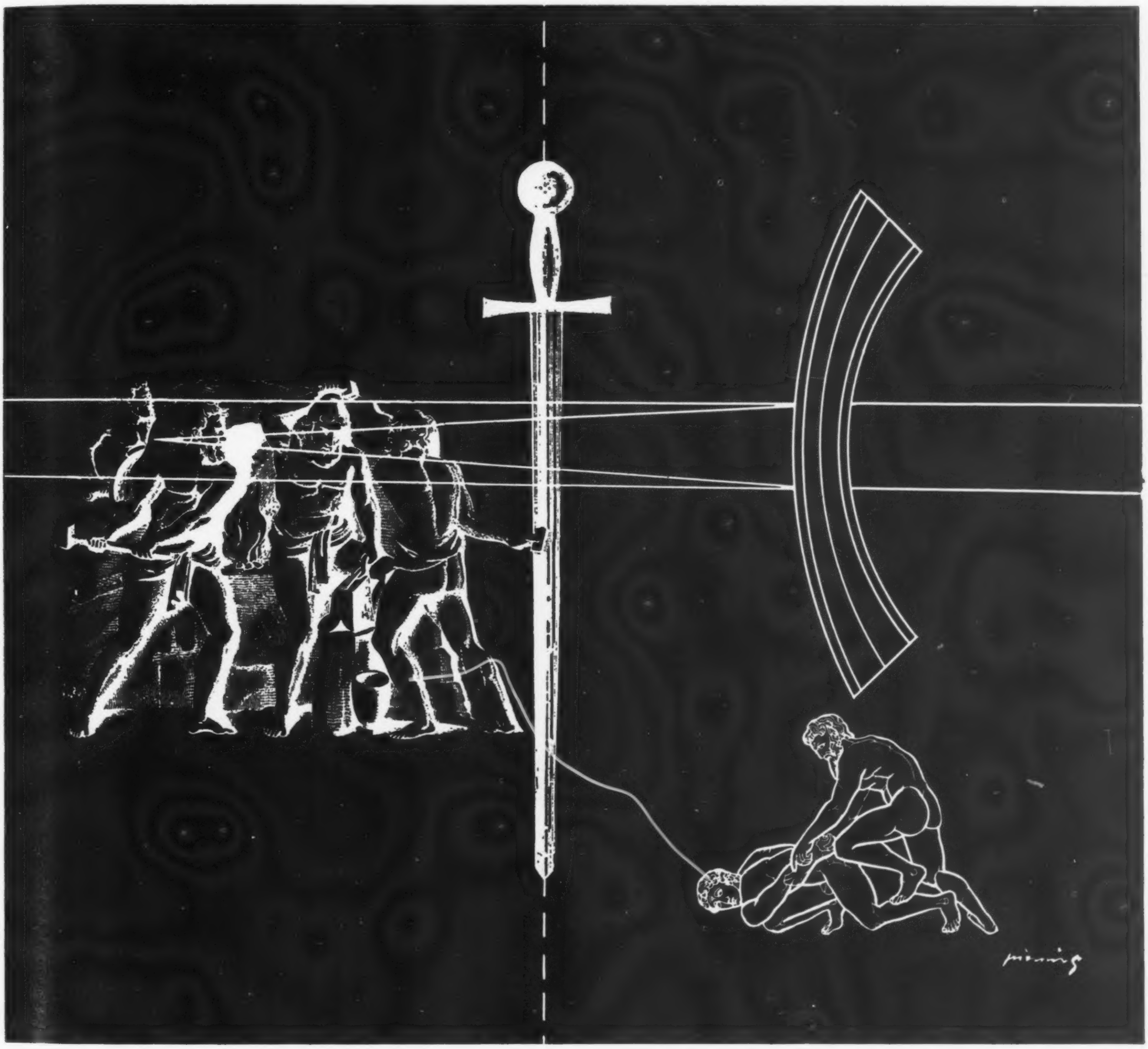
Classified Contents of This Number

Your Progress Depends Upon Your Knowledge of Your Industry

ONE CAME BACK

One of the legends surrounding the making of Damascus sword blades is that the smiths developed a delayed quench consisting of thrusting the heated blade into the body of a slave. This gave the required properties, but it was prodigal of manpower, and inconvenient besides. The smith usually had to leave town to do his heat treating in quiet.

Today, metallurgists can obtain properties they need in steel by simpler, less improvident means. A little molybdenum is one way of doing this. It is a proved means of obtaining the hardenability that assures good performance in service. Practical working data on molybdenum steels are available from Climax upon request.



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MOLY

Industry's 1947 model equipment is very much anti-friction minded, yet cost-conscious, as well. And here's where Schatz "Commercial" Ball Bearings hold the answer . . . on both counts.

Take apart a "Commercial" bearing and you find only *through-hardened*, chrome alloy precision balls, which roll on high-grade, carburized, hardened and tempered cold-rolled steel races. This inherently sturdy construction adds extra utility at every turn, greater resiliency, needed capacity for the heavier loads, and trouble-free operation. So it's not unusual to find "Commercials" rolling along in printing presses or clothes wringers, vending machines or escalators . . . delivering friction-free operation, whatever the service requirements.

"Commercial" Ball Bearings are manufactured in every standard type and size. The common denominator in each is the half-century of Schatz manufacturing experience, plus the engineering counsel that's ready to lend a knowing hand and fit the right bearing to your application.

Remember, Schatz makes only ball bearings, and "Commercials" are manufactured only by Schatz.

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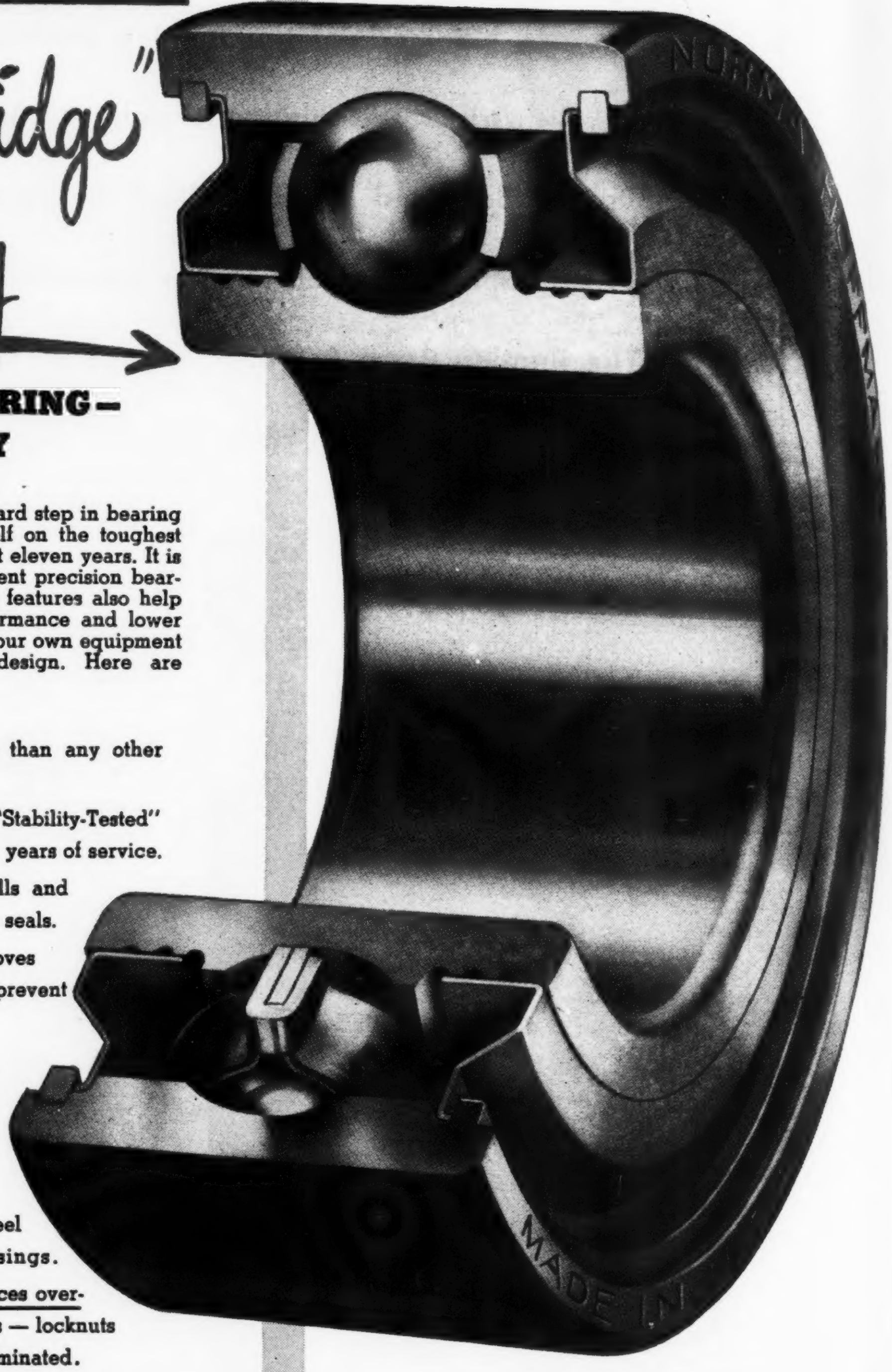
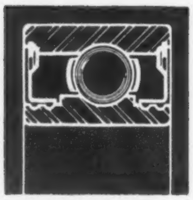
BEARING FACTS NO. 3

The "Cartridge" Bearing



TOMORROW'S BEARING— HERE TODAY



Standard Type

This revolutionary forward step in bearing design has proved itself on the toughest assignments for the past eleven years. It is not only a highly efficient precision bearing, but its self-sealing features also help you improve the performance and lower the cost of producing your own equipment through streamlined design. Here are the facts:

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- 100% more grease capacity than any other standard self-sealed bearing.
- Factory packed with Norma "Stability-Tested" grease. Relubricate only after years of service.
- Grease retained close to balls and raceways by built-in, wearless seals.
- Flanged seals with grease grooves provide a dam against leakage; prevent entrance of dirt.

How it aids Your Design Problems

- Eliminates up to 10 machining operations and up to 22 parts required with some conventional mounting.
- Prevents slippage, peening, cocking—obviates use of steel inserts in soft metal housings.
- Increases shaft strength; reduces overhang; provides compactness — locknuts and wide sealing parts are eliminated.

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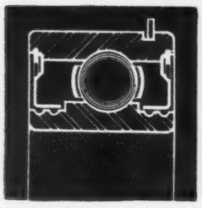
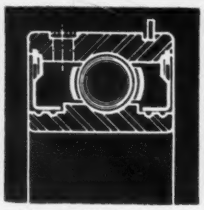
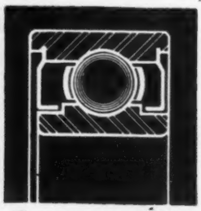
HERE ARE MAJOR VARIATIONS:



Shoulder (snap) wire. No housing shoulders needed. Seals removable.



Grease filling opening. Shoulder ring optional. Seals removable.



Permanently sealed. For shafts under 20 m/m. Seals not removable.

NOTE: Write for "Cartridge" Bearing Catalogue. Address Dept. P

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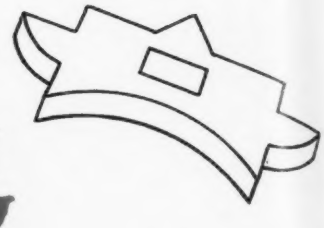
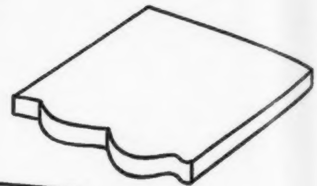
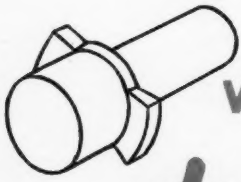






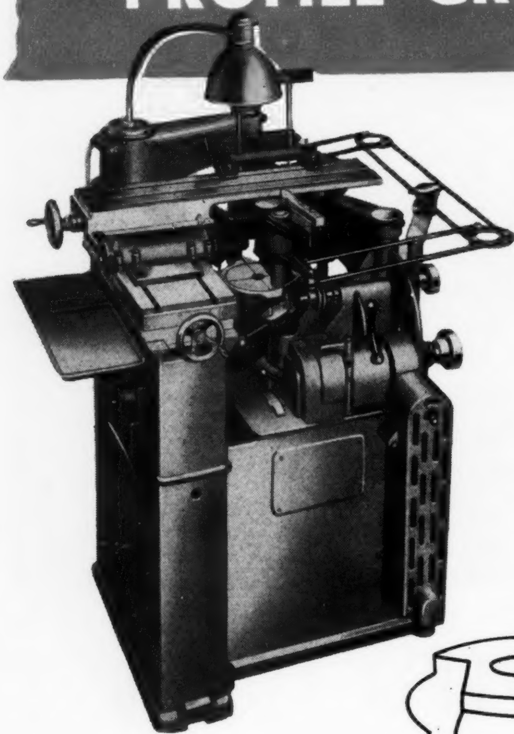
WITHIN LIMITS OF

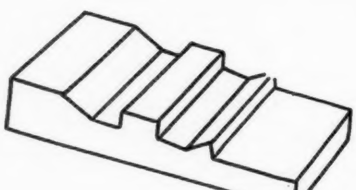
±0.0002″

Now you can perform intricate profile grinding at practical high speeds and to exceptional degrees of accuracy! With the Studer Profile Grinding Machine Type PSM you can attain accuracy to within ±0.0002″ in producing profile gages, straight or circular form tools, sectional dies, complete contours like cams, templates and similar parts of hardened steel. Profiles up to 5.9″ in length can be ground from end to end in one continuous operation without moving work-piece or template. Circular work up to 4″ in diameter can be ground, and flat pieces—several of which can be stacked for grinding at one time—can be handled up to 2″ in thickness. Small sized profiles can be accurately produced without preliminary grinding to form, and clearance angles on parts such as form tools can be ground without removing the work from its original setting.

These are the highlight features of the Studer Profile Grinder. If you can use its exceptional accuracy, its speed and ease of operation, its amazing versatility, write for complete information.

We also represent in the United States these other makers of Swiss High Precision Equipment: Societe Genevoise d'Instruments de Physique (SIP), Andre Bechler, Mikron, Safag, Sallaz, Schaublein, Lienhard, Billeter. Our engineers will be glad to work with you in specifying and using equipment for the highest precision machining.





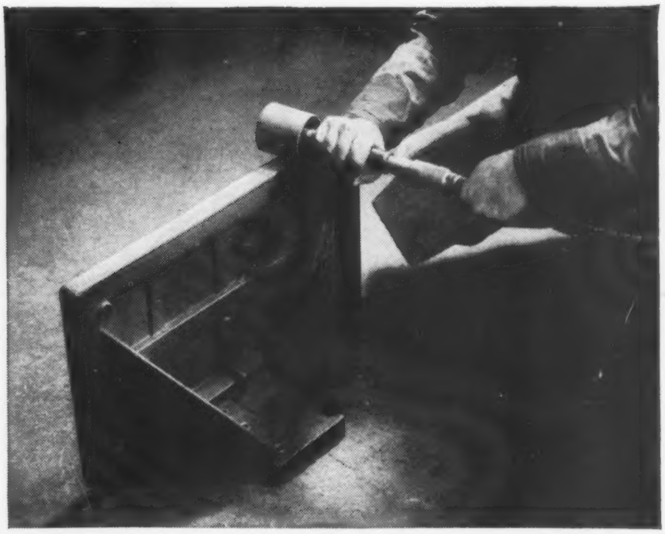
THE STUDER PROFILE GRINDER

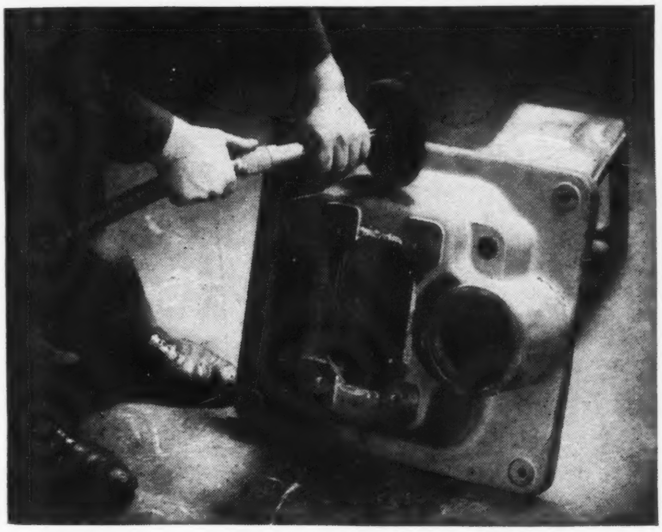
The Studer principle employs a tracer finger which follows the form of a template and transmits its movements to the grinding wheel through a pantograph. The wheel and stylus can be swiveled. Because the wheel is shaped beforehand proportionately to the exact shape of the tracer finger, an object can be ground over its entire length in one operation—with one wheel. Because a fixed template is used, errors due to incorrect manipulation are eliminated. A special template holder permits the grinding of circular forms of contours like cams over their entire circumference.

HIGH PRECISION MACHINE TOOLS AND MEASURING INSTRUMENTS

COSA CORPORATION

CHRYSLER BUILDING
New York 17, New York





INSIST ON *haskins* VERSATILITY

The Flexible Shaft Machine occupies a unique place in Industry. It is perhaps the most versatile tool in the modern shop.

Grinding—Drum and disc sanding—Rotary filing—Wire brushing—Buffing—Polishing—many other operations—all done with one Haskins Portable Flexible Shaft Machine. And done better, too—and faster—with less effort on the part of the operator. The result—a savings to you of both man power and machine hours. Send for details.

HC-5

½ H.P. Multi-speed countershaft unit. 900 to 3600 RPM. Bench-height pedestal. 360° motor swivel.

R. G. HASKINS COMPANY

617 S. CALIFORNIA AVE. • CHICAGO 12, ILLINOIS

HASKINS

haskins

FLEXIBLE SHAFT EQUIPMENT

NO OTHER *Precision Pump* COSTS SO LITTLE

This McIntyre Series 100 *precision* gear-type pump . . . for capacities from .1 GPM to 5.5 GPM at pressures from 0 to 1000 psi for hydraulic oil at speeds up to 4000 rpm . . . puts accurate performance into the smallest space. Yet it costs no more than larger pumps made to less exacting specifications.

McINTYRE PRECISION

Because McIntyre machining methods are *capable of holding flat surfaces to one light band and vital dimensions to a plus or minus tolerance of .000025″*, it is routine instead of special production when McIntyre makes precision pumps and fluid motors carrying the light-band trade-mark. That's why they cost so little.

APPLICATION FACTS

Bulletin 425 . . . describing how center plates and spur gears of different widths determine capacity . . . how they handle even corrosive liquids . . . how adapters fit all drives . . . suggests how McIntyre Model 100 precision pumps can improve performance of washing machines, dish washers, machinery control mechanisms, pressure lubrication, circulation systems for coolants, cutting oils and other fluids, and aircraft hydraulic systems. Write for your copy, specifying intended application. The McIntyre Co. 200 Riverdale Ave., Newton 58, Mass.

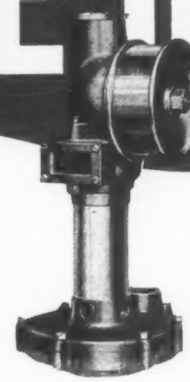
Pump shown slightly larger than actual size

THE McINTYRE CO.

PUMPS AND FLUID MOTORS

THE ULTIMATE IN PRECISION — *IDENTIFIED BY THE LIGHT BAND*

DYNAMICALLY BALANCED!



SMOOTHER ACTION!

HIGHER PRECISION!

LONGER LIFE!

Every rotating part of every Gusher Coolant Pump is now dynamically balanced! You can install a Gusher Pump on your finest jig borer, your most accurate grinder, on any machine where even a slight amount of vibration can affect precision, and know that Gusher's smooth, steady operation will contribute to the accurate results you want.

And wherever you install them, Gusher Coolant Pumps, with their twin features of Dynamic Balancing and All Ball Bearing Construction, give you longer trouble-free service. Coolant pump repairs are brought down to an irreducible minimum when Gusher Coolant Pumps are installed.

Ruggedness, accuracy, dependability are built into every part of Gusher Coolant Pumps. There are no metal-to-metal contacts in the impeller; grit and small chips flow right through without clogging or damaging the pump. They have fewer moving parts and a rugged, one-piece shaft. They are designed to start instantly, without priming and they can be throttled to any extent without building up pressure.

Dynamic balancing . . . plus ball bearing construction . . , plus all these other features make Gusher Coolant Pumps the choice of the leading builders of the finest machine tools. Types, sizes and capacities to fit almost every requirement. The Ruthman Machinery Company, 1807-1823 Reading Road, Cincinnati 2, Ohio.

THE COOLANT *Heart* FOR A GOOD MACHINE

GUSHER COOLANT PUMPS

WITH "ES"

Heavy Duty

COMPRESSORS

- Sizes 5 to 125 hp.
- Liberal valving with Channel Valves.
- Free-air unloaders on each inlet valve.
- Thorough water-jacketing around all valves.
- Completely accessible, oil-tight frame.
- Double-row Timken bearings.
- Constant-speed control; or dual control, permitting either constant-speed or automatic-start-and-stop.
- Pressures 5 to 150 psi single stage.
- Also to 500 psi two-stage; 2500 psi three-stage.
- V-belt, flat-belt, or drive by synchronous motor mounted on crankshaft. Also steam drive with steam cylinder between air cylinder and frame.

If you need a long-life compressor...one that has the stamina to generate Air Power continuously at full capacity, 24 hours every day, week after week...*you need an Ingersoll-Rand Class "ES."*

This heavy-duty compressor is designed, built, tested, and rated for severe service throughout many years. In addition, it is the most efficient, trouble-free single-stage compressor available. For these reasons an "ES" will save you hundreds, perhaps thousands, of dollars during its lifetime.

Whenever you have problems concerning Air Power... its generation, its distribution, or its thousands of labor-aiding uses...call on an I-R Engineer. He can help you in many ways.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

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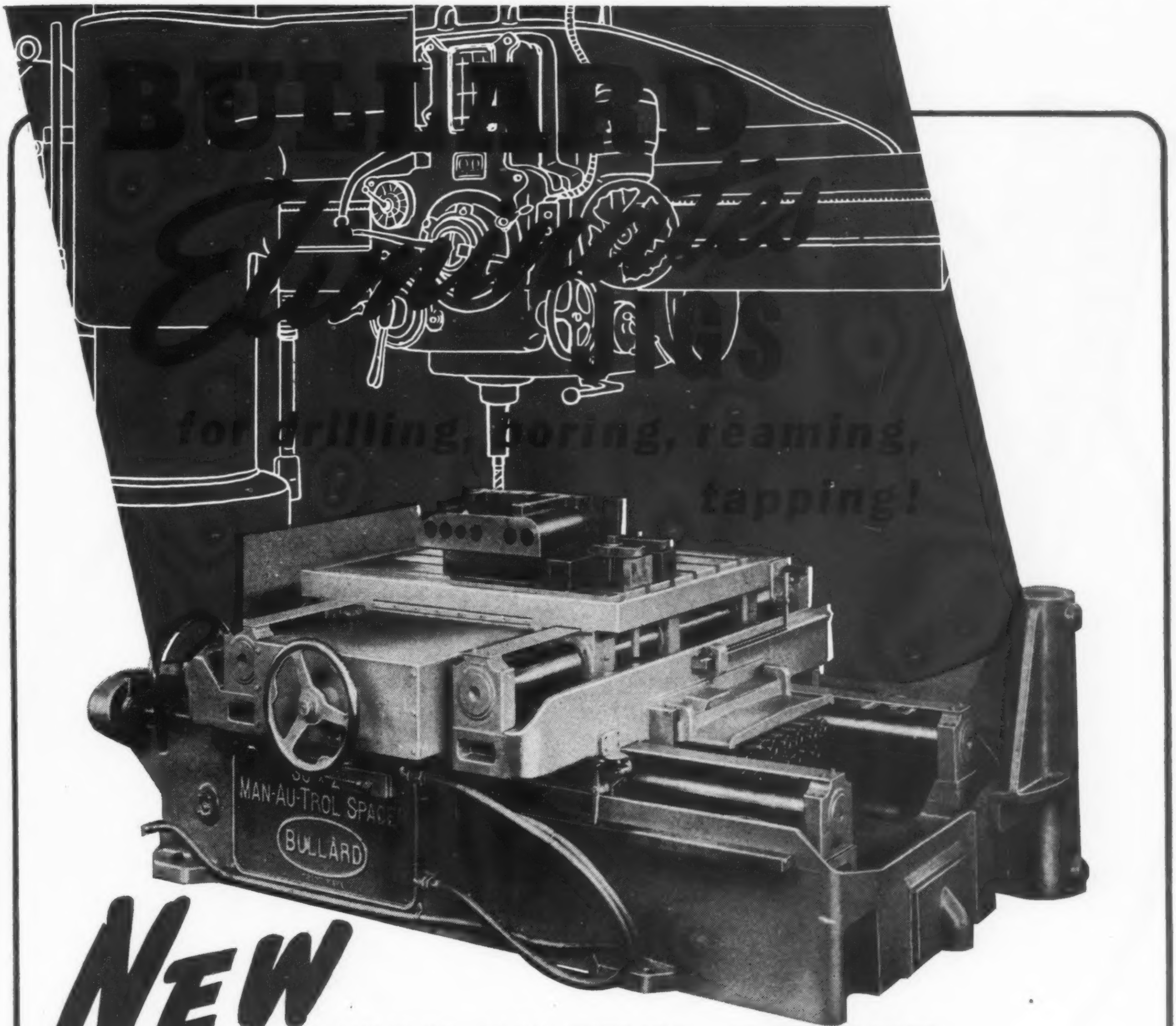
COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES



NEW

MAN-AU-TROL SPACER

Designed for installation *by you* on your drills, the new Bullard MAN-AU-TROL Spacer, in most cases, eliminates hole-locating jigs... and the time, money and labor required to design, make, handle, repair and store them.

With unprecedented speed, ease and accuracy, you can set up the Spacer to do the work of jigs that may take weeks or months to make. Once its lateral and longitudinal position stop rods are set for a pattern of holes, the manually controlled, automatically operated Spacer will repeat that pattern indefinitely *to the highest standard of commercial spacing accuracy.* Extreme flexibility permits the use of the Spacer on a large variety of large and small work.

The results: faster, more accurate production... lower costs... less overhead... less human fatigue—all valuable factors in improving your competitive position. Write for MAN-AU-TROL Spacer Bulletin.

BULLARD

CREATES NEW METHODS TO MAKE MACHINES DO MORE

Made in 2 sizes—30" x 20" (illustrated) for larger work on 4', 5' and 6' Radial Drills; and 4" x 4" for work usually done on smaller types of drills.

THE BULLARD COMPANY

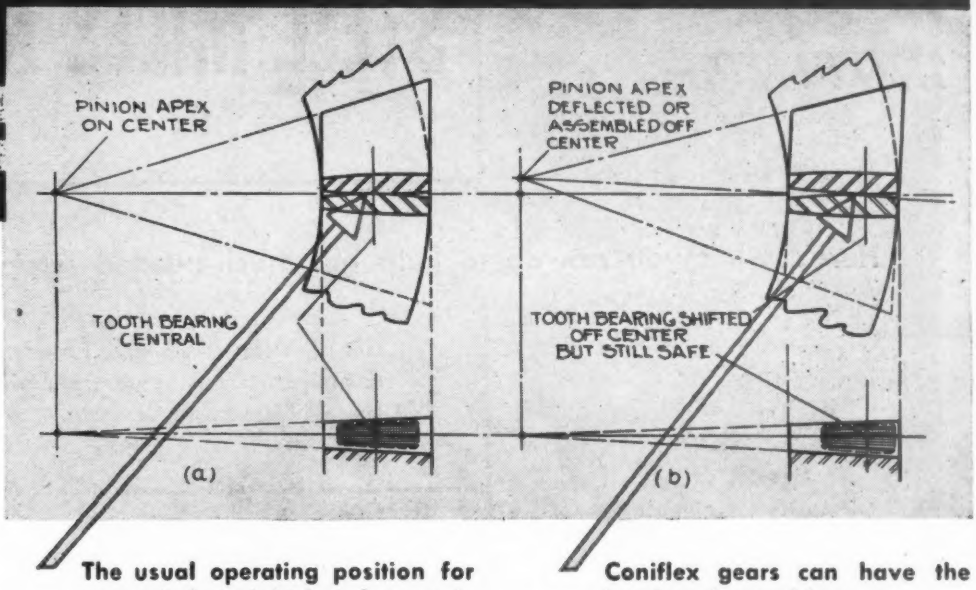
BRIDGEPORT 2, CONNECTICUT


PAIRED FOR PRECISION
JOHN BATH CO
7/8 9 NC
HS
Fast-cutting accuracy, economical long service, and dependable uniformity. You need all three to make tapping operations really pay off. In short, you need Bath Taps. And for equally fast, economical, profitable inspection of your Bath-tapped holes, you need Bath Gages. Both are designed to contribute to production efficiency. Both are partners in production — paired for precision. John Bath and Company, Inc. Worcester, Mass.
BATH
BATH TAPS AND GAGES


MADISON-KIPP
Aluminum Die Casting
highest daily production potential in the history of metal founding . . .
Whether your requirements are for small or large parts, if your quantities are substantial enough to support economical production, there is no process, we believe, that can equal die casting from the standpoint of pleasing product appearance, accuracy, strength and lightness. All of these advantages apply at no cost penalty and often at substantial savings.
The die casting industry is notable for its excellent mechanics who produce one success after another.
MADISON-KIPP corporation
203 WAUBESA STREET, MADISON 4, WISCONSIN, U. S. A.
Skilled in die casting mechanics, experienced in lubrication engineer
of really high speed air tools.
ENS ATELIERS GASQUY, 31 Rue du Marias, Brussels, Belgium
agents for
Belgium, Holland, France, and Switzerland.
ULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most
countries, India, Australia, and New Zealand.

CONIFLEX

THE BEVEL GEAR WITH LOCALIZED TOOTH BEARING

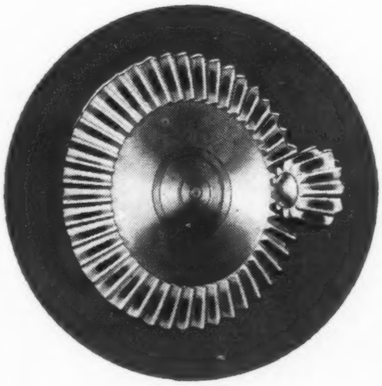


The usual operating position for generated straight bevel gears is here.

Coniflex gears can have the bearing changed here.

— and this can be done without dangerous concentration of load at the ends of the gear teeth.

The latest Gleason Straight Bevel Generators, in the medium and large sizes, have a positive cam-controlled advance of the tool slides at each end of the cutting stroke . . . result: a gear tooth relieved at the ends for:



1. **WIDER OPERATING TOLERANCES**
2. **SMOOTHER QUIETER OPERATION**
3. **EASIER ASSEMBLING**

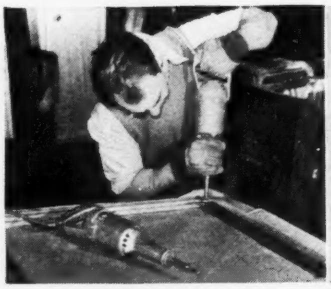
For informative literature on Coniflex gears write for "Generated Straight Bevel Gears."

GLEASON Works
1000 University Avenue
Rochester 3, N. Y., U. S. A.

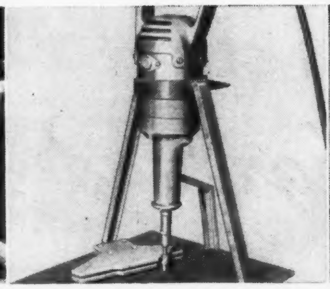
Builders of Bevel Gear Machinery for Over 80 Years


A REAL HE-MAN JOB!
Both man and grinding wheel on this snagging job must be plenty tough . . . and toughness is one of the features scientifically "built" into BAY STATE SNAGGING WHEELS AND CONES. This rugged quality is not all. BAY STATE'S special resinoid and vitrified bonds assure faster, cleaner, stock-removing action, resulting in a definite increased economy. Our unique method of rigidly imbedding the steel nut, on the taper cup shapes, is an added safety factor.
Detailed snagging wheel bulletins . . . either portable snagging or for heavy swing frame and floor stand grinders are yours for the asking.
BAY STATE ABRASIVE PRODUCTS
Top Performance Consistently Duplicated
BAY STATE ABRASIVE PRODUCTS CO. • WESTBORO, MASSACHUSETTS, U.S.A.

DUMORE
No. 9 HG
¼ HP — 15,500 RPM
¼" capacity chuck



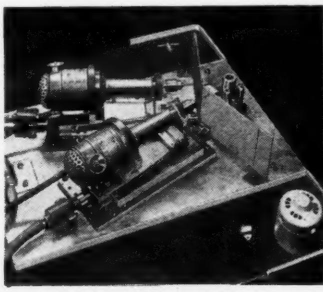
Cleaning Welded Joints



Contour Milling Hard Copper

Spark-Testing Steel

DUMORE
No. 10 HG
1/10 HP—22,000 RPM
⅛" capacity chuck

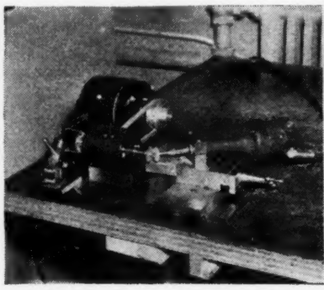


Automatic Drill Head

Touching-Up a Forging Die

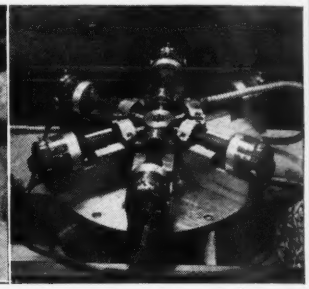
De-Burring Gear Teeth

DUMORE
No. 8 HG
1/20 HP—18,000 RPM
⅛" capacity chuck



Automatic De-Burring Unit

Finishing Plastic Mold



Automatic Hex-Screw Drilling Unit

YOU can do an endless variety of jobs with a sturdy, serviceable Dumore Handgrinder

Its rugged durability guarantees efficient, trouble-free service

When you have a job that requires a good handgrinder, select a Dumore. Grinding is only the first of many jobs you can do with these versatile tools. They have scores of other applications (a few illustrated on this page) — polishing, finishing, sanding, burring, scoring, touching up, drilling, milling, and many more.

Dumore Handgrinders are more than just hand tools. Many ingenious users have built special machines in which the work heads are one or more Dumore Handgrinders. Such machines are reliable, low-cost production units requiring minimum maintenance attention.

Dumore Handgrinders are sturdy tools — designed to give long and dependable service — built to stand up under the constant strain of heavy production schedules.

You can find many spots in your plant where service difficulties can be eliminated, production simplified and speeded up, by using Dumore Handgrinders. Ask your nearby distributor to recommend the right size for your needs. Write for complete information. The Dumore Company, Racine, Wisconsin.

TEAR OUT AND MAIL COUPON TODAY!

FREE — Catalog 42

THE DUMORE COMPANY, Dept. K-28, Racine, Wisconsin

Please send without obligation, Catalog 42, describing your complete line of tools and grinders.

Name.................................... Position....................................
Company....................................
Address....................................
City.................................... (......) State....................................

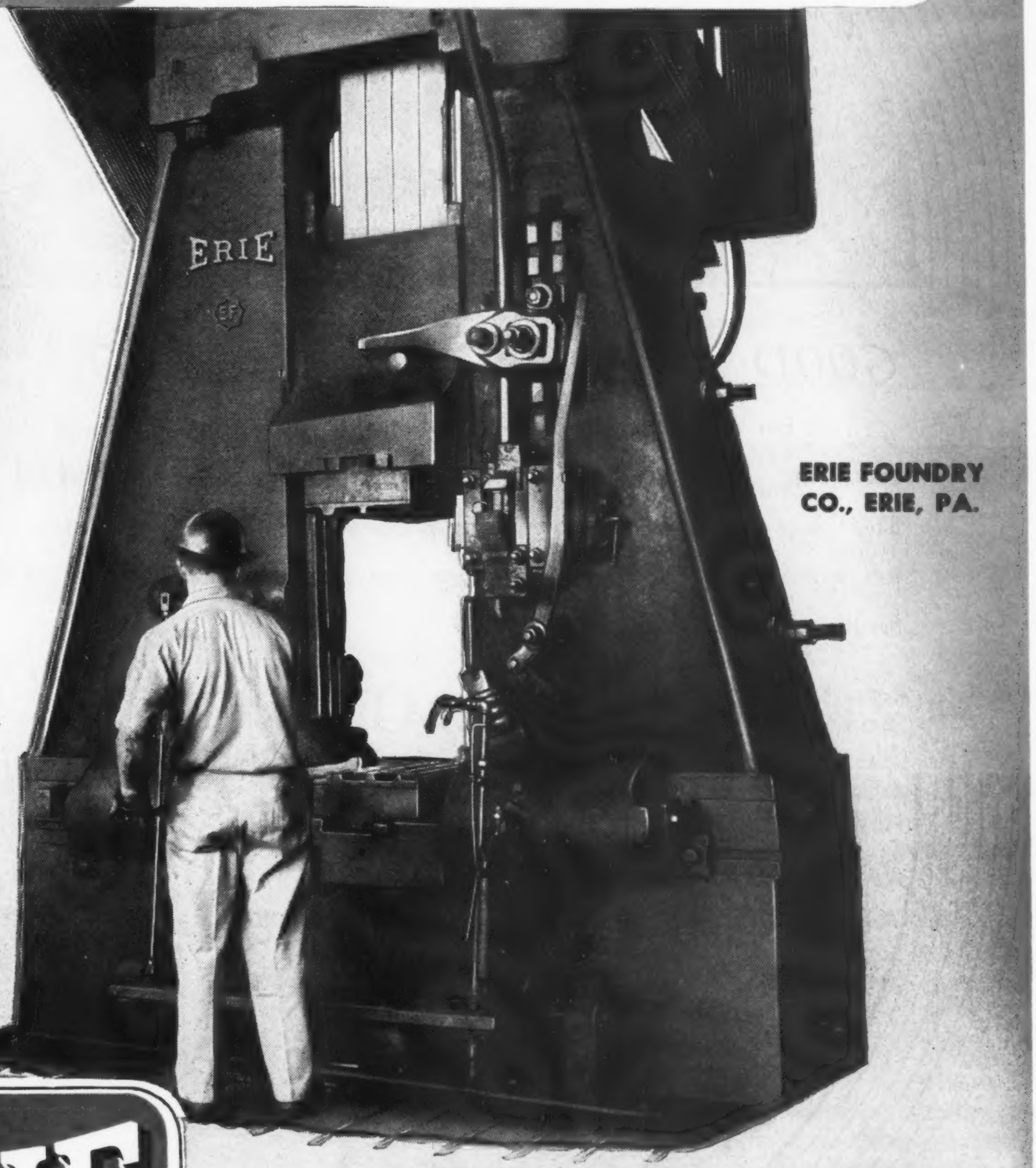
DUMORE
PRECISION TOOLS

Sold by leading industrial distributors in all principal cities

Board Drop Hammers are Rugged

ERIE

Erie Board Drop Hammers combine all the improvements developed during Erie's 50 years of experience in designing and building drop forging hammers. Into the Erie Board Drop Hammer has been designed and built the same ruggedness you find in all Erie Hammers. It gives you the reliability and strength of the heaviest Erie Steam Hammers. The result . . . economy in operation which no forge shopman can afford to overlook. Erie Board Drop Hammers are rated from 400 to 10,000 lbs.



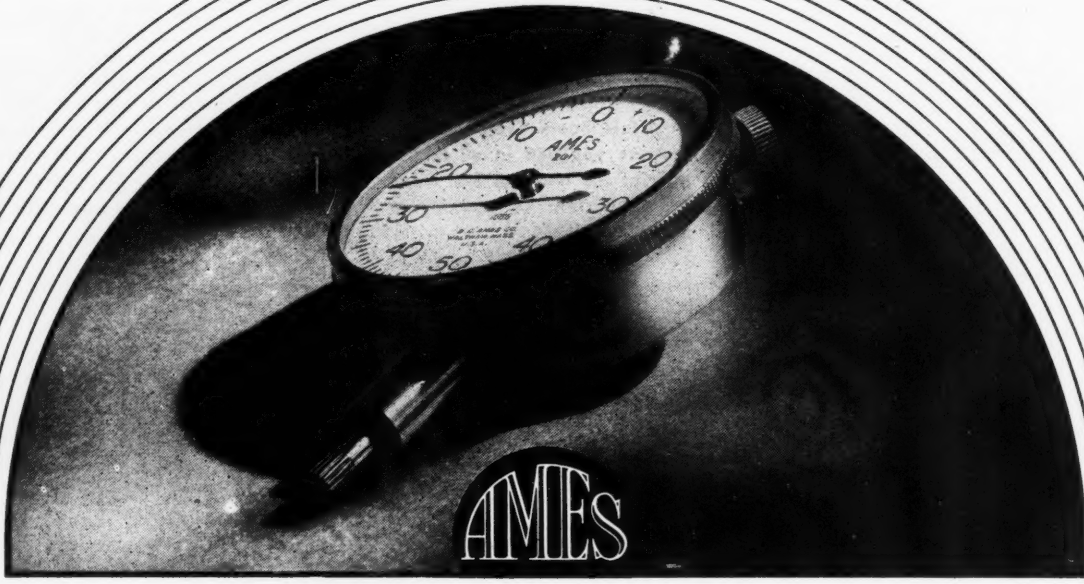
ERIE FOUNDRY CO., ERIE, PA.

The 4,000 lb. Erie Board Drop Hammer above is completing the forging operation in the shop of a large tool manufacturer.

For full details write for Bulletin 339

ERIE

ERIE BUILDS *Dependable* HAMMERS



GOOD IN THE 4TH *DIMENSION, TOO!*

For tool checking or tough production jobs, Ames Dial Indicators are *time-conserving* as well as sensitive and accurate. They're *quickly* mounted and adjusted. Their dials are *instantly* readable. But *most time-saving* is their ability to stay *right* on the job, without internal adjustment—*longer* than any other indicator you can buy. Send for illustrated Catalogue.

Representatives in principal cities

B. C. AMES CO.

27 Ames Street
Waltham 54, Mass.

MANUFACTURER OF MICROMETER DIAL GAUGES AND MICROMETER DIAL INDICATORS

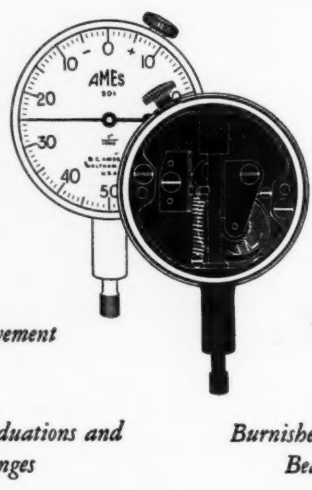
4 Sizes—60 Models

English or Metric Measure

Balance or Continuous Dials

Plain or Compound Movement

Many Graduations and Ranges



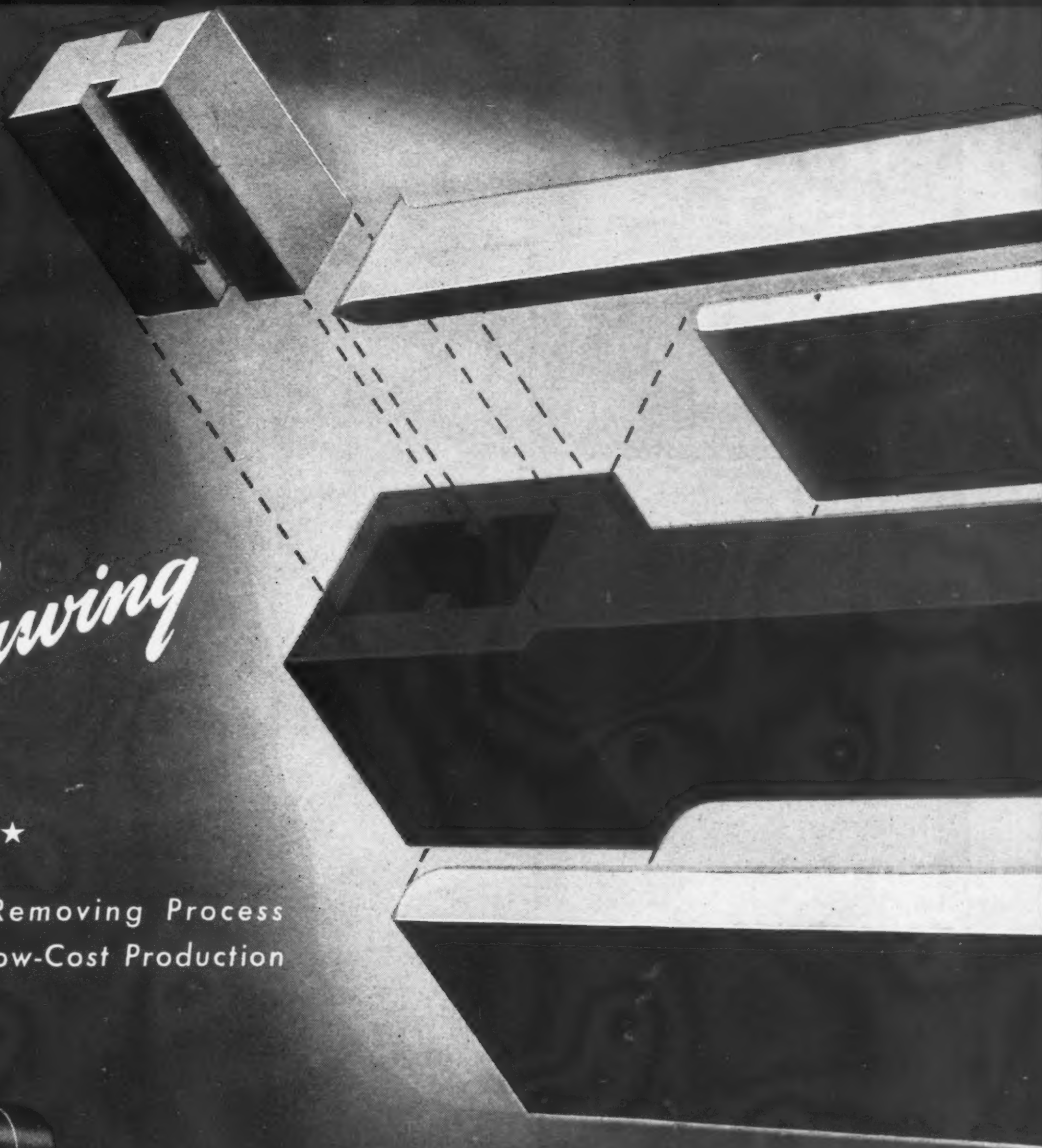
Forged Brass Case and Stem

Hardened Steel Staffs and Pinions

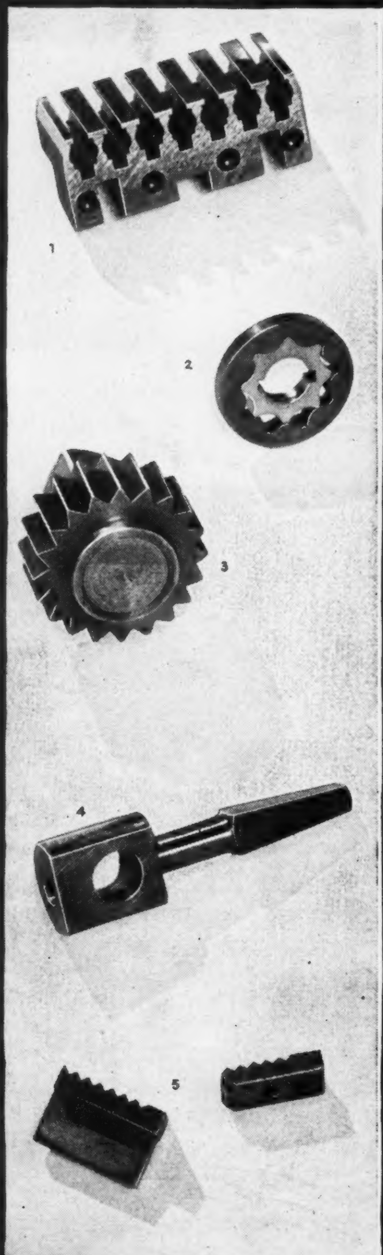
Forged Wheel Supports

Hardened Steel Guidepin and Guide Block

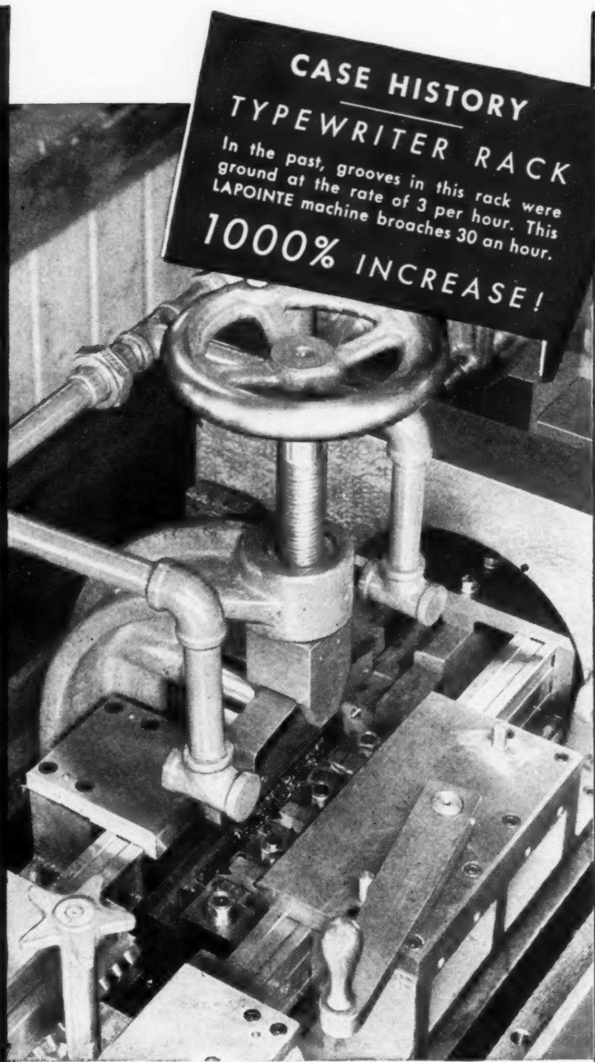
Burnished Hardened Bearings

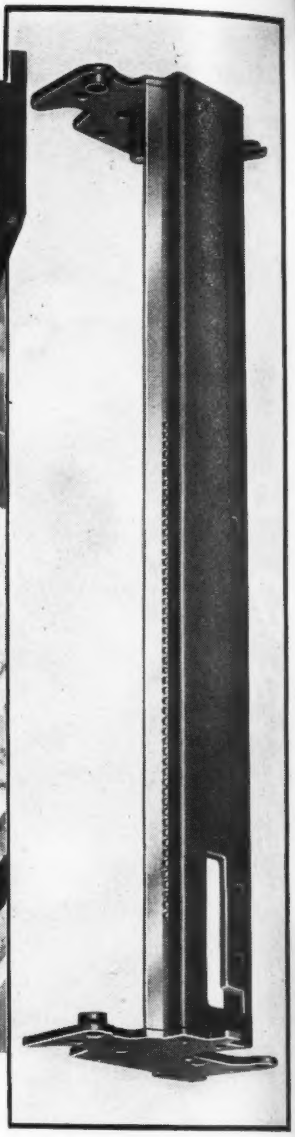


TYPICAL
BROACHING
JOBS THAT
Cut Costs
MAYBE YOU HAVE
SIMILAR
PROBLEMS



1. Rayon Stocking Machine Part
2. Gerotor Gear
3. Ratchet Wrench Gear
4. Tool Bit Holder
5. Plier Jaws





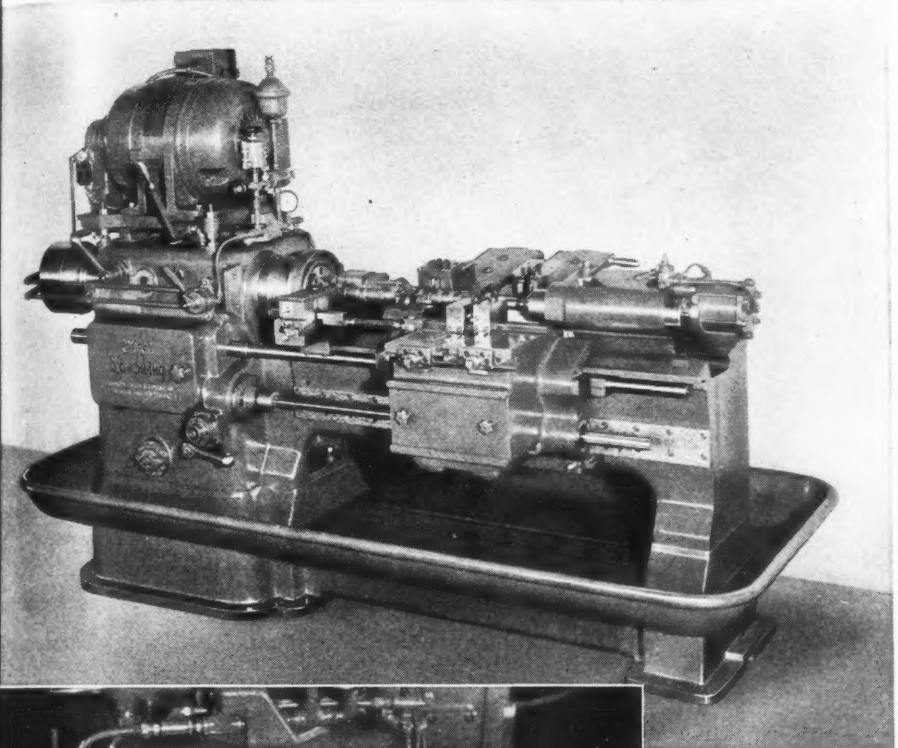
BROACHING gives you increased Production, Precision, Lower Cost.

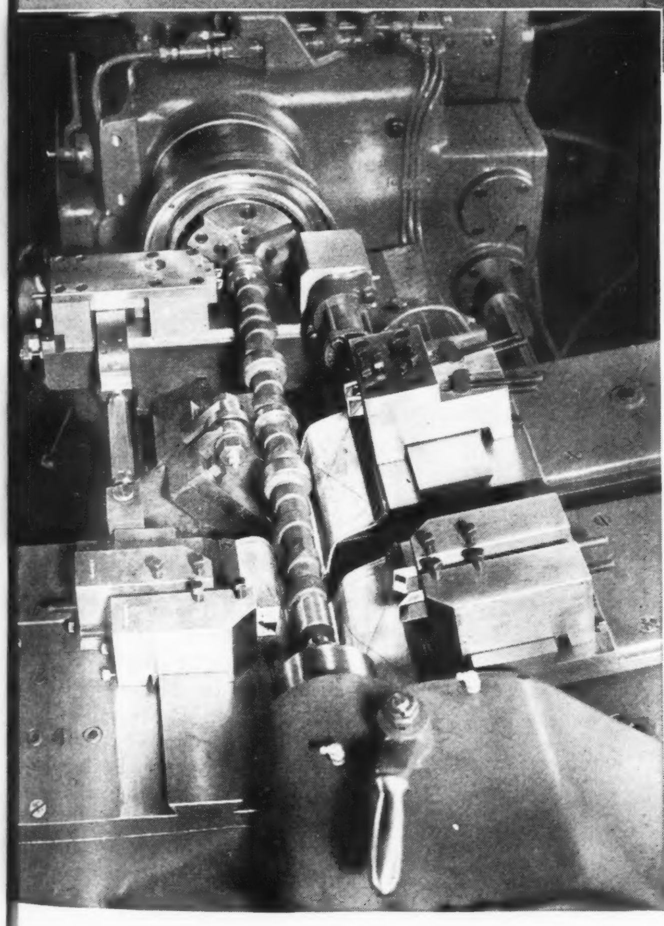
Where continuous contour is desired, through or over any piece of metal, broaching generally is the most efficient method of cutting. This is particularly true when large volume, exact tolerances, time and costs are important. Let LAPOINTE engineers show how broaching can help *you* cut costs.

THE *Lapointe*
MACHINE TOOL COMPANY
HUDSON, MASSACHUSETTS, U. S. A.
OLDEST AND LARGEST MAKERS OF BROACHES AND BROACHING MACHINES

ACHINE OF THE MONTH

ARED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YORK





Lo-swing
AUTOMATIC LATHE

incorporates unique features for cam-shaft job and

Reduces the Number of Operations Required

Problem: **To perform the following operations on a 6-cylinder cam-shaft: Cut double eccentric oil groove on head bearing; rough and finish turn small bearing; chamfer small bearing; face and chamfer oil pump drive gear.**

Solution: **A 5x34" model "LR" Lo-swing Lathe was selected for this job. It was equipped with a standard 2-slide carriage, 2 back squaring attachments, front steady rest, a double eccentric grooving attachment and an automatic 2-speed headstock. This 2-speed headstock and its automatic control are one of the unique features of the tooling for this particular job. Since cemented carbide tools were used, high speeds were essential for finish turning and squaring operations, yet were impractical for the double eccentric grooving operation. The lathe automatically shifts from high speed upon completion of turning and squaring operations, and goes into low speed for the double eccentric grooving operation.**

The cam roller on the double eccentric grooving attachment is automatically withdrawn from the cam path during the high speed portion of the cycle.

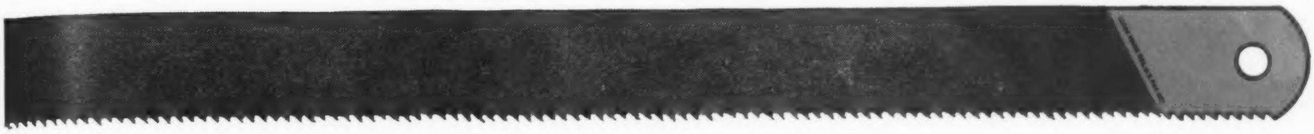
Another interesting feature of this lathe is the 2-slide carriage which accomplishes both roughing and finishing cuts on the small bearing. The roughing tool on the front slide relieves from the work before the tool on the second slide moves in for the finish cut.

Consult our Engineering Department for time-saving equipment.

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

ATHE NEWS from SENECA FALLS

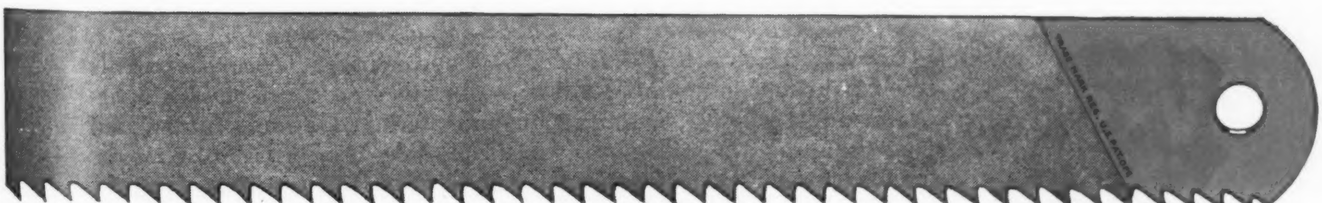
Get SIMONDS

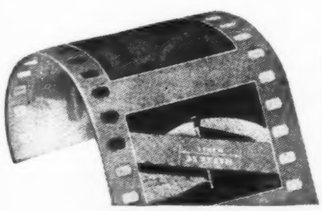


"RED END" HACKSAW BLADES

...AND GET A LONGER RUN

FOR YOUR MONEY





SEE SIMONDS SOUND-FILM, in color, showing how to get the best results and longest service out of the finest blades made...SIMONDS "Red End" Blades for Hand and Power Hacksawing. You can arrange with your Industrial Supply Distributor for a showing of this interesting movie. Or write to the nearest Simonds office.

SIMONDS SAW AND STEEL CO.
FITCHBURG, MASS.

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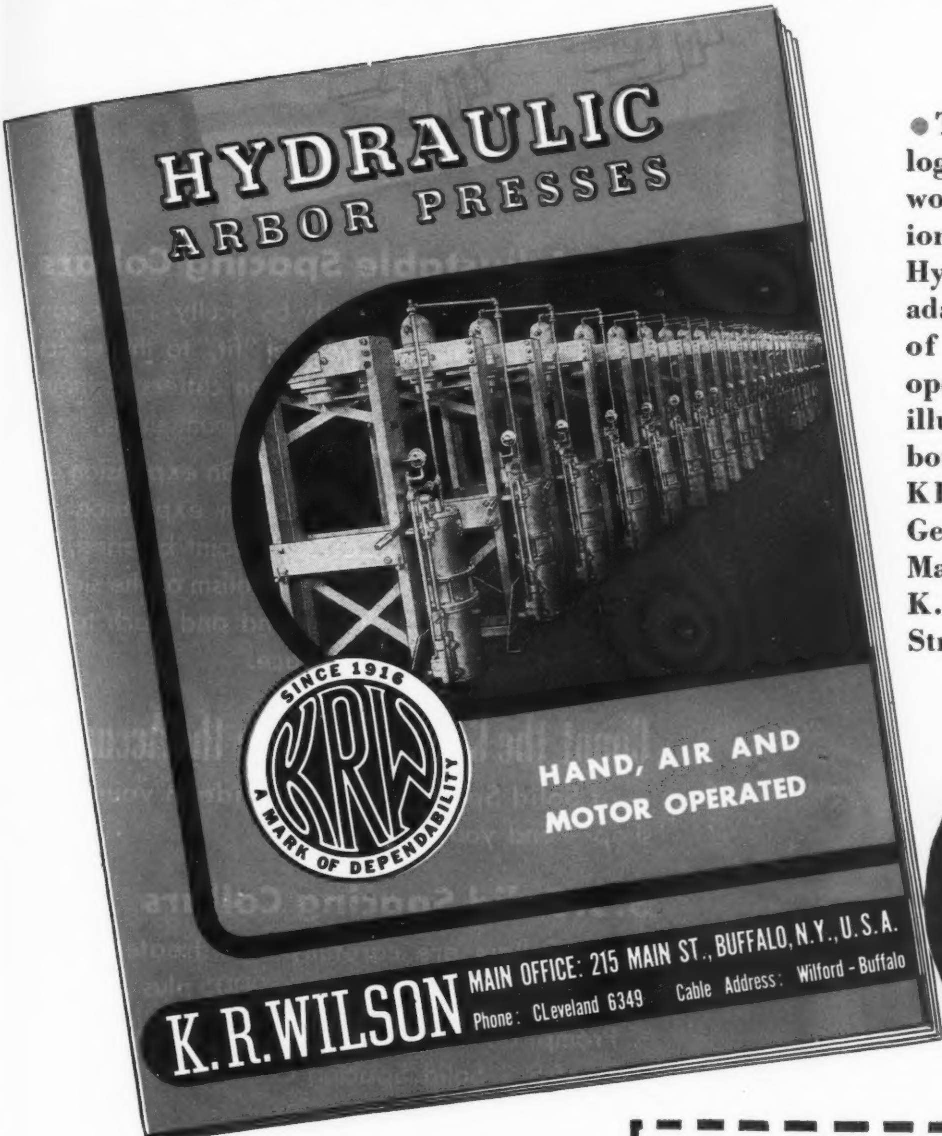
NEW KRW
HYDRAULIC PRESS BOOK
of Profitable Production Ideas



● This is more than a catalog . . . it is a textbook of workable, practical suggestions on how low-cost KRW Hydraulic Presses can be adapted to solve a myriad of everyday production operations. 32 completely illustrated pages that show both standard and special KRW Presses in operation. Get your Free Copy now... Mail the coupon at once. K. R. Wilson, 215 Main Street, Buffalo 3, N. Y.

NOW AVAILABLE
AS
HAND OPERATED
ELECTRIC OPERATED
AIR OPERATED
Presses...

K. R. WILSON
BUFFALO 3, NEW YORK

K. R. WILSON, 215-217 Main Street, Buffalo 3, N. Y.
Please mail me a copy of your New Hydraulic Arbor Press Catalog.

Name ....

Address ....

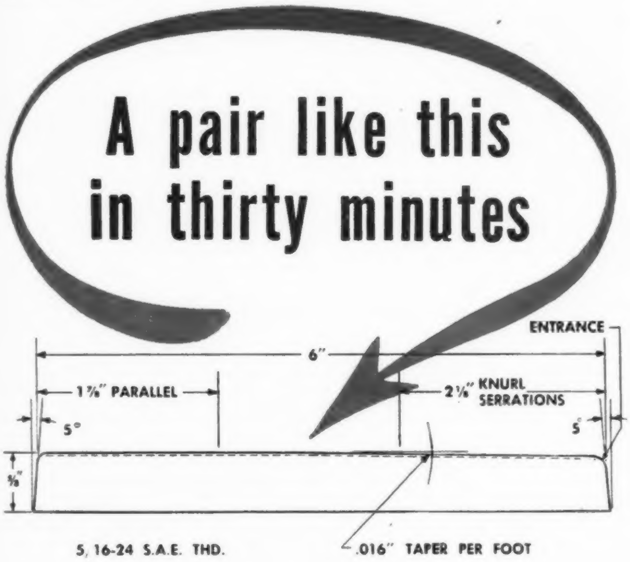
City & Zone .... ***State*** ....

15

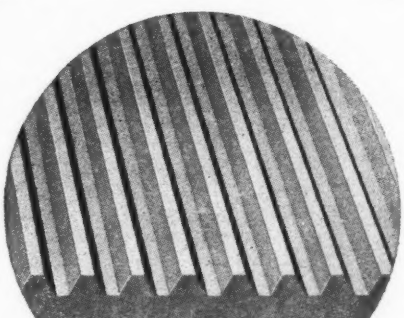
GRIND thread rolling dies?

... *the answer is* YES!

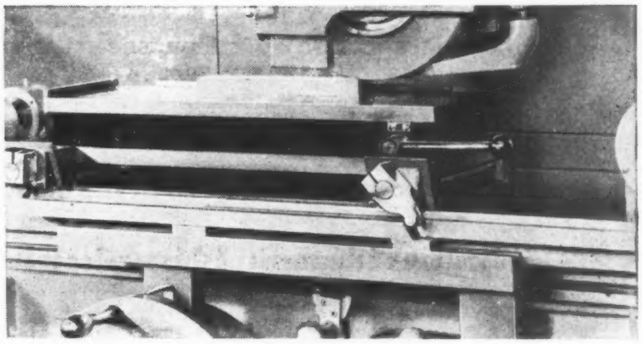
Now—through a new application of THOMPSON TRUFORMING—you can produce accurate duplicate roll thread dies and eliminate subsequent corrective operations formerly required. An example is the roll thread die shown here.



This is the Stationary Die (a perfect mate to the Moving Die not shown). Both were ground on a THOMPSON TRUFORM grinder from heat-treated alloy steel in less than thirty minutes. Note the radii, the precise taper and flat section. This is produced with a single cut—to full depth of thread form without resetting.



Enlarged tooth section shows form of threads and helix angle. By TRUFORMING dies are perfectly matched . . . there is no distortion.



Deformities are eliminated by TRUFORMING because work is finished right in hardened steel. Note the special forming fixture in the photograph, which makes possible completely automatic and highly accurate grinding of the longitudinal contour. These Thompson die grinding features are new with patents applied for.

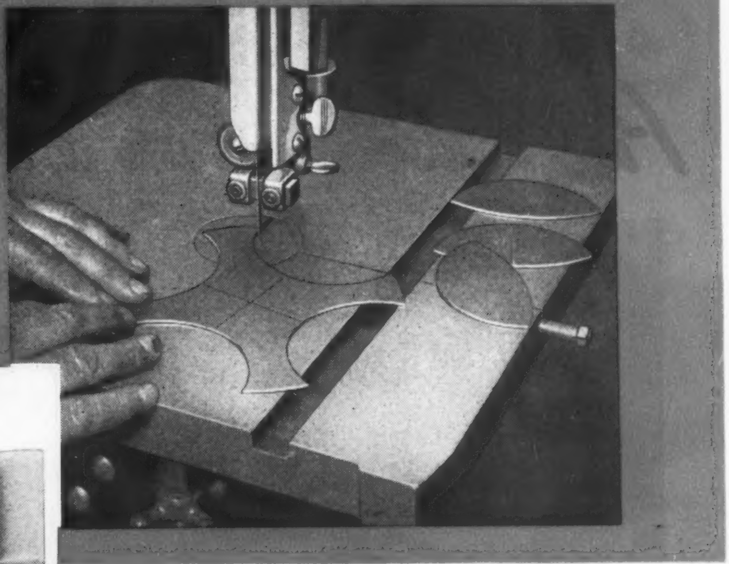
Longer die life and greater die accuracy, plus ability to regrind dies without drawing, are three great advantages you get with this THOMPSON TRUFORMING application.

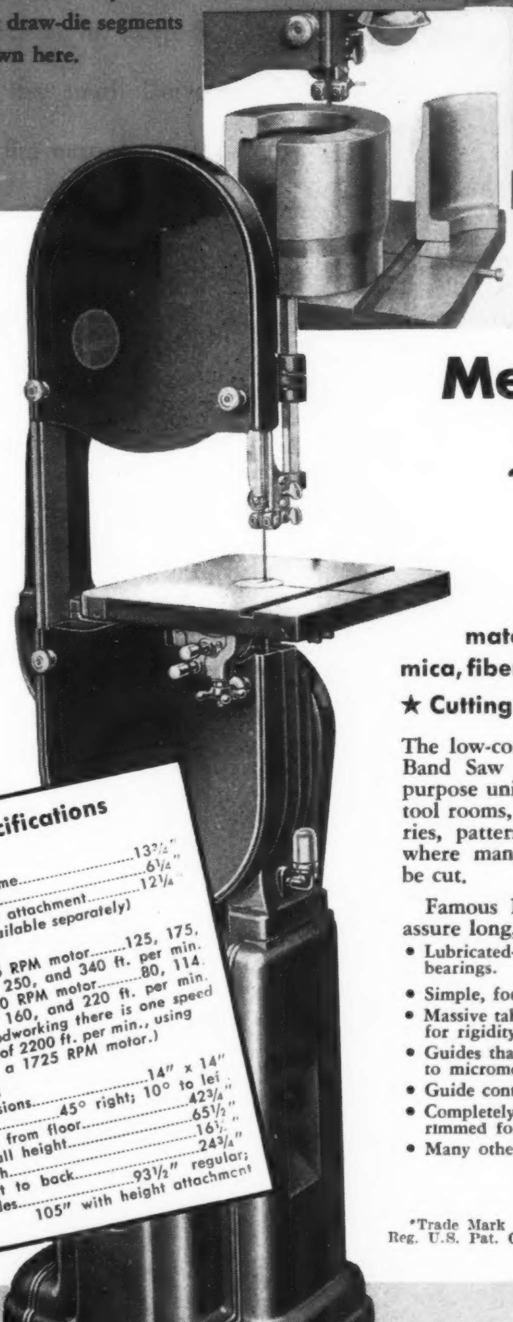
Write at once for complete details . . . Address Dept. 12.

The Thompson Grinder Company • Springfield, O.

Right: In addition to using it for cutting cast iron jig and fixture bases 1½" and 2" thick to segments 6" thick, one plant uses its Delta Metal-Cutting Band Saw for all miscellaneous sheet-metal cutting, such as templates, structural shapes, parts for experimental machines, etc.

Below: A machine-shop superintendent says that the Delta Metal-Cutting Band Saw saved its cost on the first few jobs of cutting draw-die segments as shown here.





4 metal-cutting speeds

•

1 wood-cutting speed

DELTA*

Metal-Cutting Band Saw

...quickly pays for itself on many applications

★ Cutting almost any material . . . steel, plastics, mica, fiber, carbon, vulcanite, etc.

★ Cutting templates.

☆ Sawing off tool, die, and fixture stock.

★ Trimming gates in iron, brass, aluminum.

The low-cost Delta 14" Metal-Cutting Band Saw is an economical general-purpose unit for use in machine shops, tool rooms, experimental shops, foundries, pattern shops, and other places where many different materials must be cut.

Famous Delta construction features assure long, trouble-free life:

- Lubricated-for-life New Departure ball bearings.
- Simple, foolproof gear drive.
- Massive table mounted on double trunnions for rigidity.
- Guides that can be independently adjusted to micrometer accuracy.
- Guide controls at front of table for safety.
- Completely guarded, safety-type wheels, rimmed for easy tire renewal.
- Many other advantages that benefit you.

Enjoy the economy and versatility of the Delta Metal-cutting Band Saw. Install it in your plant. See your Delta distributor — listed under "Tools" in the classified section of your telephone directory.

Mail coupon below for free Bulletin A-28.

• • •

Delta tools are typical products of the American way of doing business. In America, we use tools to create more and better things at lower cost than in any other country, and in this way provide better living — for only as people work together to produce more can they have more to enjoy.

Delta Manufacturing Division
Rockwell Manufacturing Company
Milwaukee 1, Wisconsin

Specifications

Capacity:
Blade to frame....................13¾"
Under guide....................6¼"
With height attachment....................12¼"
(available separately)

Speeds:
With 1725 RPM motor.......125, 175, 250, and 340 ft. per min.
With 1140 RPM motor.........80, 114, 160, and 220 ft. per min.
(For woodworking there is one speed only of 2200 ft. per min., using a 1725 RPM motor.)

Table:
Dimensions....................14" x 14"
Tilt..........45° right; 10° to left
Table from floor....................42¾"
Overall height....................65½"
Width....................16½"
Front to back....................24¾"
Blades..........93½" regular; 105" with height attachment

M-20

*Trade Mark Reg. U.S. Pat. Off.

ROCKWELL

DELTA MILWAUKEE

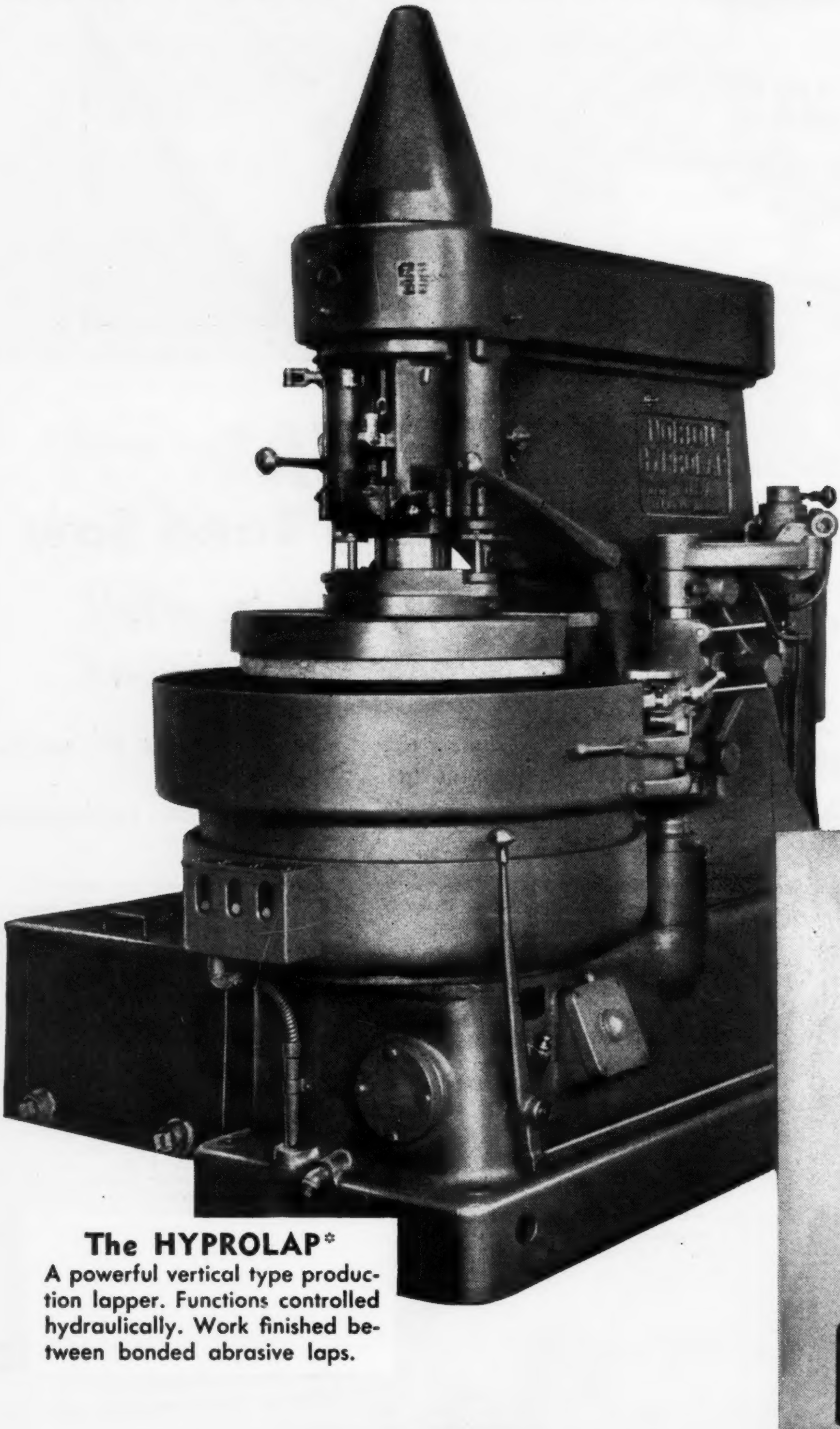
TEAR OUT COUPON AND MAIL TODAY!

DELTA MANUFACTURING DIVISION
607M E. Vienna Ave., Milwaukee 1, Wisconsin

Please send me Bulletin A-28 on Delta Metal-Cutting Band Saw.

Name....................
Position....................
Company....................
Address....................
City....................(......) State....................

Put Precision on a Production Basis..



The HYPROLAP*
A powerful vertical type production lapper. Functions controlled hydraulically. Work finished between bonded abrasive laps.

Type No. 10-U
The smallest of the vertical lappers and a universal machine which does both flat and cylindrical lapping, using cast iron laps.

NORTON GRINDERS* *and Lappers*

*Trade-marks Reg. U. S. Pat. Off.

with NORTON LAPPING MACHINES

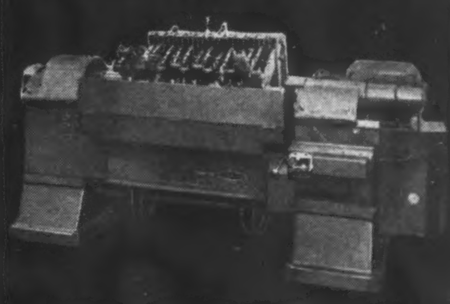
NORTON has a complete line of lappers —they range from the powerful Hyprolap* machine for large flat and cylindrical pieces to the small Universal 10-U, widely used in the manufacture of plug gages and size blocks. In addition there are special lapping machines built for finishing crankshafts and camshafts. All are rugged, productive machines capable of finishing surfaces within extremely close tolerances. They are easily operated and easily maintained.

Individual catalogs are available on the various types of Norton Lapping Machines.

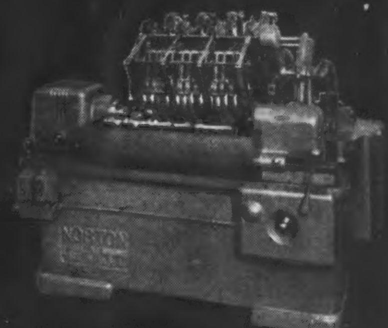
Tell us what you are interested in lapping.

NORTON COMPANY, Worcester 6, Mass.
Distributors in All Principal Cities

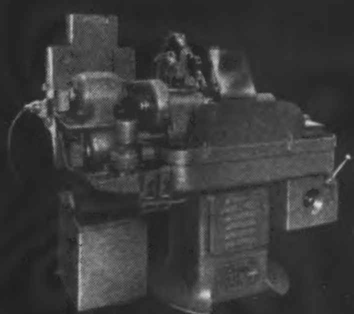
M-525



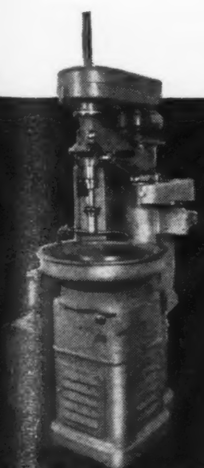
Type 40 Crank-O-Lap*



Type 30 Cam-O-Lap*



Simplex Lapper



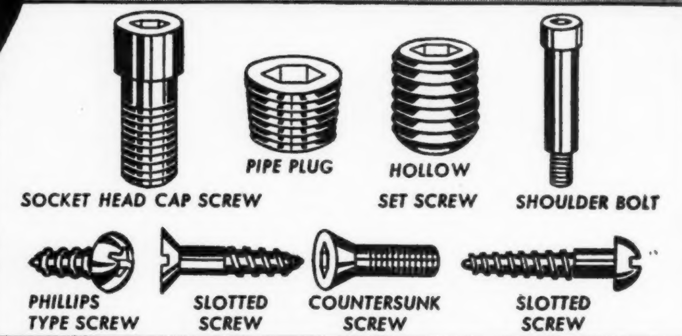
Single Spindle Rotary Seal Lapper

No. 2 Vertical Lapper

No. 2 Hand Lapper

BITS

FOR DRIVING ALL THESE SCREWS



Contained in this Handle

Handle is molded of sturdy Celanese* plastic; tools are of high grade alloy steel.

HALLOWELL

"SOCKET SCREW" KIT

with interchangeable bits

For men who like to have a complete supply of tools, yet dislike bulk and confusion, the Hallowell "Socket Screw" Kit is the answer. It is one of the neatest tricks of the year. The hollow Celanese* plastic handle holds interchangeable bits for most all purposes . . . Phillips, Hex and Flat. There is a swivel bit-chuck, which locks securely in position, and makes it possible to twirl a screw using the vertical position, and then snapping the chuck to an angle or ell position, to get the final tightening pull.

Not illustrated: "Socket Wrench" Kit; the "Auto" Kit; the "Home" Kit. Write for our 8-page booklet that fully describes these handy Tool Kits. Obtainable at Suppliers throughout the country.

If your Supplier does not carry these Kits, send his name to us, along with yours, and you will be taken care of promptly.

Kits: Patents Pending

OVER 43 YEARS IN BUSINESS

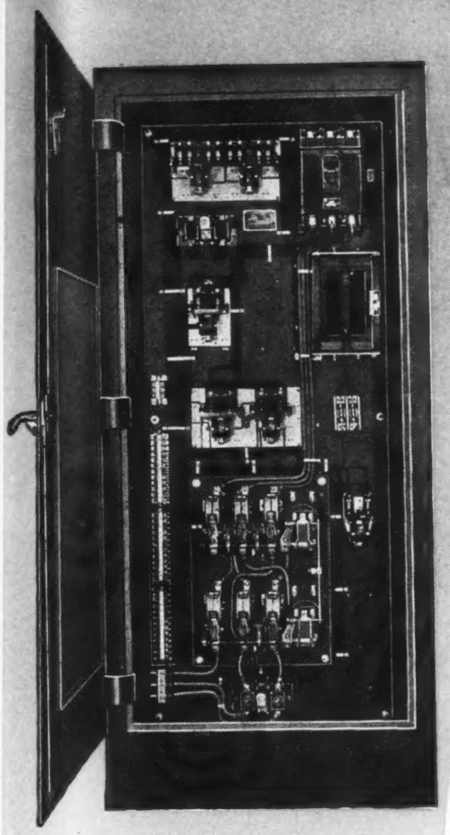
*Reg. U. S. Pat. Off.

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 23 • BRANCHES: BOSTON • CHICAGO • DETROIT • INDIANAPOLIS • ST. LOUIS • SAN FRANCISCO

FOR SAFETY'S SAKE

. . . Use "3C" Press Control to take the hazards out of Power Press Operations



Bulletin 9505 Press Control

Fourteen years of development effort in cooperation with power press shop Engineers produced Clark Patented Anti-Repeat Press Control. Its exclusive safety features and operating advantages give maximum protection to both operator and press, and also aid in maintaining production.

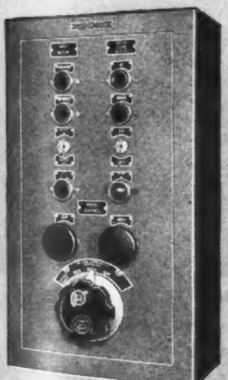
"3C" Bulletin 9505 Complete Press Control equipment is used with all types of power driven presses such as the air operated friction clutch and brake, direct drive, hydraulic and special types. It combines heavy duty devices—selected for their safety features and long operating life—into a smooth-working, low maintenance engineered function.

Here are some typical safety features of "3C" Press Control:

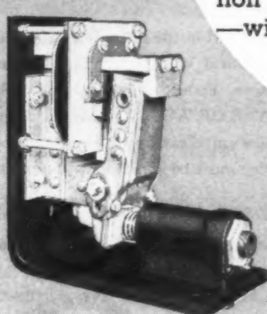
- **Anti-Repeat circuit design prevents false operation of press due to short circuits or grounds. No danger of second stroke while operator removes the completed piece.**
- **Proper interlocking, complete factory wiring, then unit testing.**
- **Tamper-proof, oil-tight, short stroke, palm operated push buttons.**
- **Selector Switch and "Run" Push Button equipped with cylinder locks to prevent tampering.**
- **Magnet air valve—designed expressly for press control work—provides protection against sticking open.**
- **Special non-freezing silver alloy contacts in press circuit.**
- **One enclosure houses circuit breaker, motor starters and press control.**

Clark Anti-Repeat Press Control gives not only the vital safety features listed above, but helps maintain high press production as well. A Clark representative—there's one near you—will gladly consult with you on any press control problem.

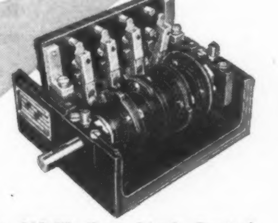
Ask for fully descriptive Bulletin 9505.



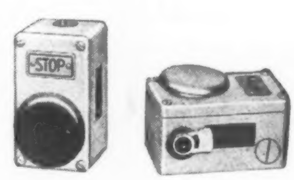
Master Panel



Bulletin 5735 Magnetic Air Valve (Cover Removed)



Bulletin 102-CL Cam Limit Switch (Cover Removed)



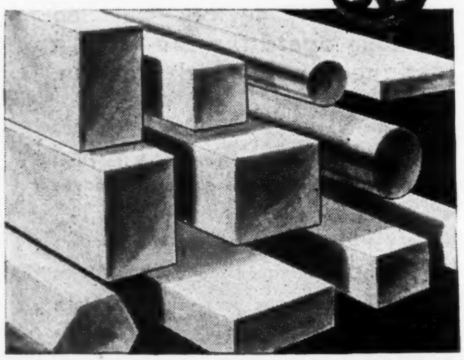
Bulletin 100 Type C Stop and Run Push Buttons

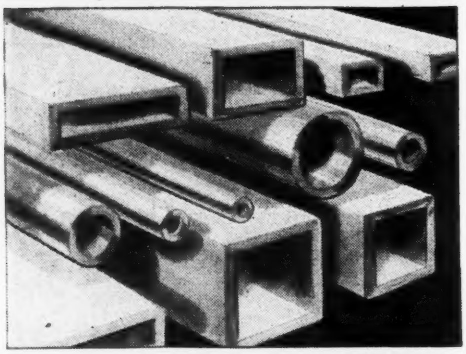
THE CLARK CONTROLLER CO.

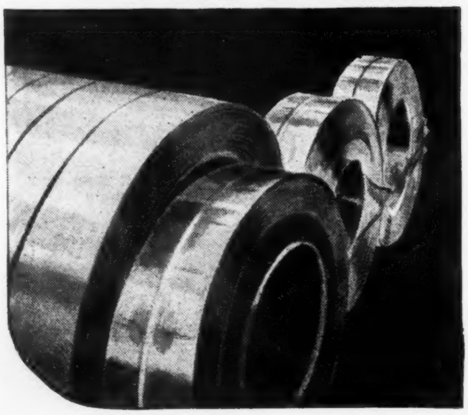
1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

NOW

Brass Mill Products Quickly!







A large supply of brass mill products is now offered to the trade at unusually low prices. The entire inventory may be fabricated by normal production methods and is being sold in production quantities.

The inventory includes: Free Turning Brass Rod—1 inch diameter and larger; Copper and Brass Tubing—3 inch O.D. and larger; Naval Brass Rod—various diameters; Aluminum Bronze, Manganese Bronze and Silicon Bronze in various shapes.

• • •

This material is offered in the following sequence as provided by law: (1) Certified Veterans of World War II; (2) Subsequent priority claimants; (3) Non-priority purchasers. Federal agencies have had opportunity to fulfill their needs. VETERANS OF WORLD WAR II should apply to their nearest WAA Regional Office for certification; the case number assigned and the location of the certifying office must be stated in a Veteran's offer to purchase.

EXPORTERS: **The War Assets Administration solicits your inquiries. Communicate with your foreign clients promptly.**

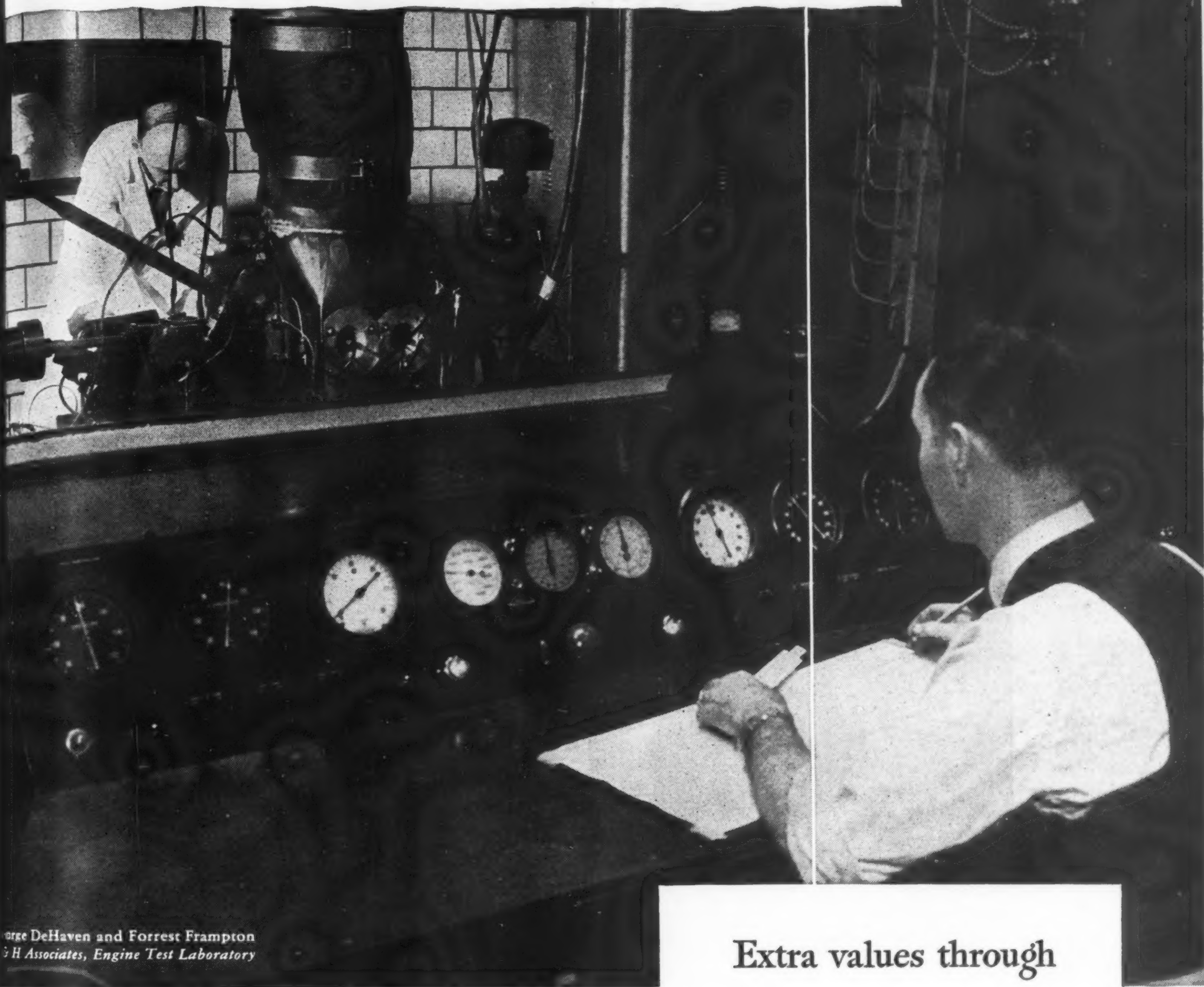
WAR ASSETS ADMINISTRATION

GOVERNMENT OWNED SURPLUS

Offices located at: Atlanta • Birmingham Boston • Charlotte • Chicago • Cincinnati Cleveland • Dallas • Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville Kansas City, Mo. • Little Rock • Los Angeles Louisville • Minneapolis • Nashville • New Orleans • New York • Oklahoma City Omaha • Philadelphia • Portland, Ore. Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane

157-8A

Racetrack in a Laboratory



...orge DeHaven and Forrest Frampton
...H Associates, *Engine Test Laboratory*

Extra values through

JACK & HEINTZ

Mass Precision

You are looking into one of the "torture chambers" of our engine laboratory where the world's largest pressure-die-cast, four-cycle engine is going through its paces. Under sustained tests this new Jack & Heintz slide-valve engine reveals exceptional fuel economy. Its weight is far less than that of conventional automobile engines. It is more efficient and has a much wider speed range.

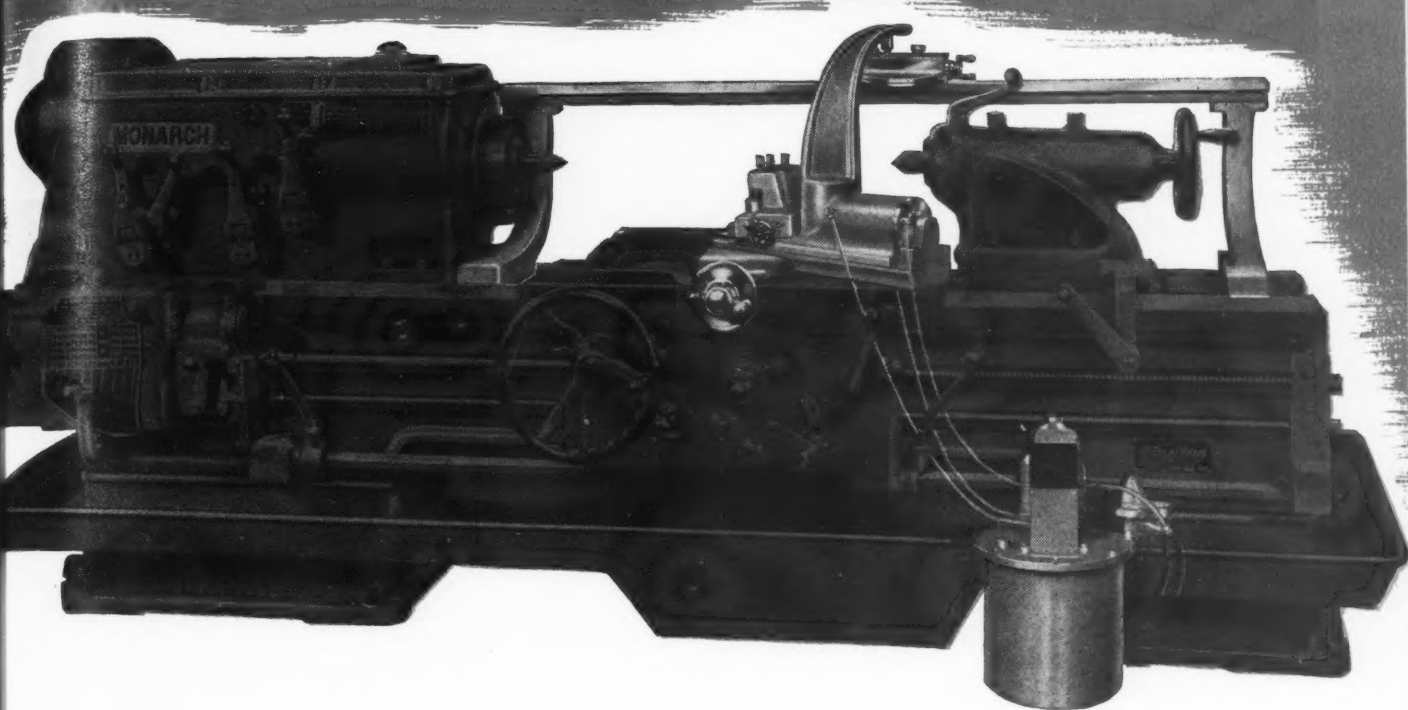
This new engine is typical of Jack & Heintz achievements through *mass precision.* This rare combination of high precision and mass production is creating better engines, electric motors, refrigeration compressors, aircraft accessories, bearings and magnetos *today,* and is developing other revolutionary products for *tomorrow.*

JACK & HEINTZ PRECISION INDUSTRIES, INC., *Cleveland 1, Ohio*

Good Tools are the first step in reducing shop and tool-room costs. This 36-page booklet illustrates and describes Williams postwar line of quality Machinists' Tools. Ask for your copy. Williams Tools are sold by leading Industrial Distributors everywhere.

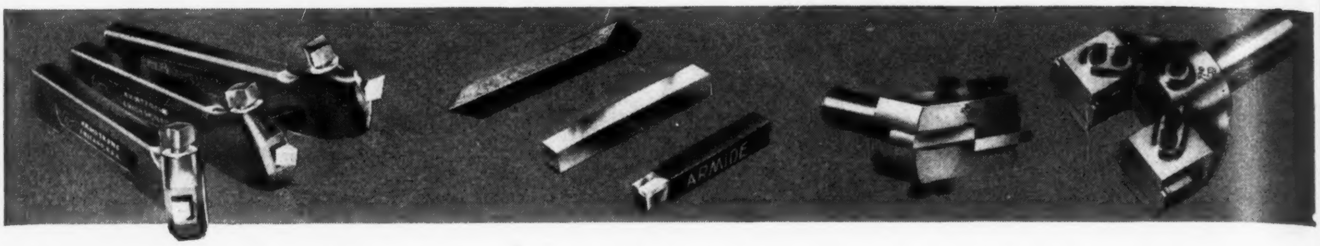
J. H. WILLIAMS & CO., BUFFALO 7, NEW YORK

Williams Light, Boring-Tool Holder. A handy and economical tool for light boring, internal threading and turning.



ARMSTRONG

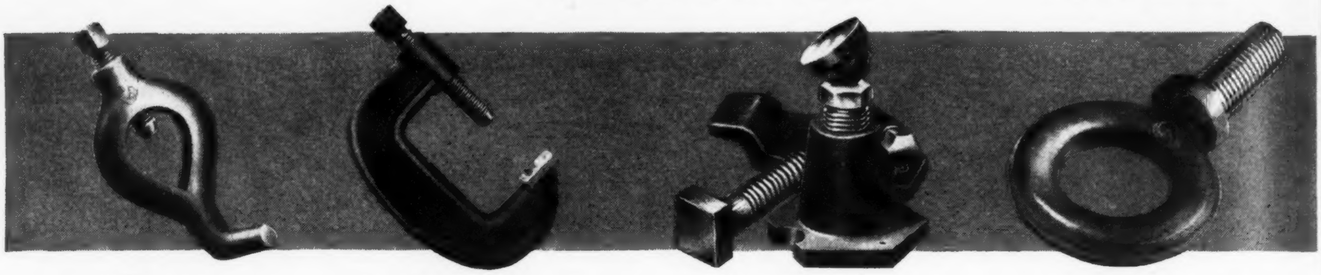
Quality TOOLS



ARMSTRONG TOOL HOLDERS
Permanent, multi-purpose tools, for every operation on Lathes, Planers, Slotters and Shapers.

ARMSTRONG HIGH SPEED
Ready-to-grind Bits...Ground Cutters.
ARMALOY Cast Alloy CUTTER-BITS
ARMIDE Carbide-Tipped CUTTERS
6 cutter shapes, 12 sizes—2 grades.

ARMSTRONG Turret Lathe and Screw Machine TOOL HOLDERS
Drill Holders, Cutter Holders, Finishing and Knurling Tools for standard operations.

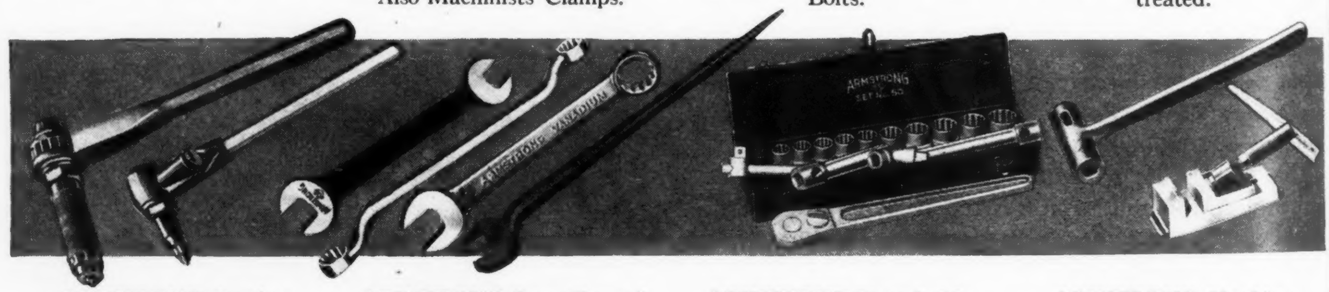


ARMSTRONG Drop Forged DOGS
Lathe Dogs, Milling Machine Dogs, and Clamp Dogs. 12 types, all sizes.

ARMSTRONG Drop Forged "C" CLAMPS
Heavy Duty, Medium Service, Deep Throat, and Tool Makers' types in all sizes. Also Machinists' Clamps.

ARMSTRONG Setting Up Tools
A complete line of Drop Forged Strap Clamps, Planer and Bracing Jacks and T-slot Bolts.

ARMSTRONG Drop Forged Eye Bolts
Plain or shoulder pattern. Blank or Threaded. 14 sizes, Drop Forged and heat treated.



ARMSTRONG Ratchet Drills
All steel wearing parts hardened. Packer, Railroad, Standard, and Short types, both plain and reversible.

ARMSTRONG Drop Forged Wrenches
Both Carbon and Alloy Steel. Over 100 types in all sizes. Improved designs, steels, and heat treating ... stronger.

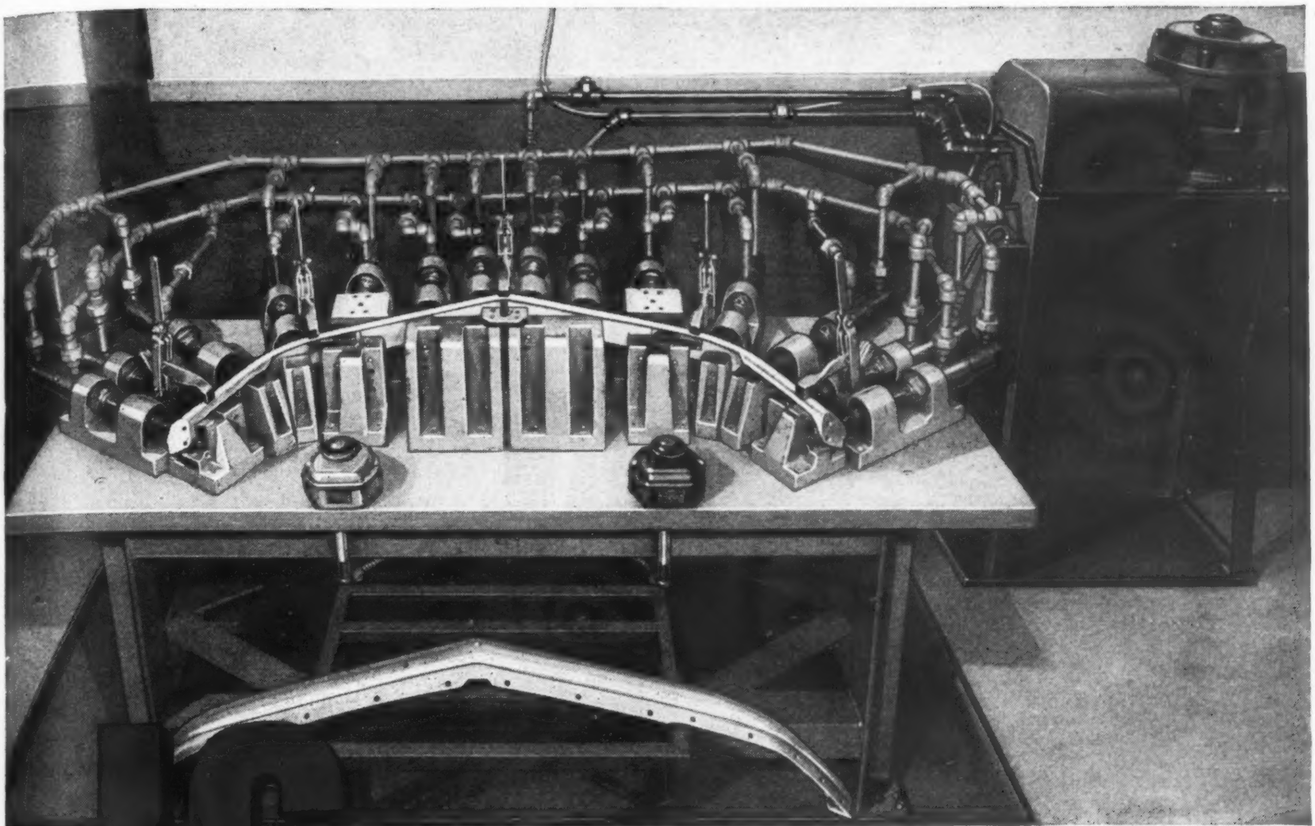
ARMSTRONG Detachable Socket Wrenches
All sizes and types with driving handles, extensions, and drop forged ratchets. Sold singly or in cased sets.

ARMSTRONG Machine Shop Specialties
Drill Drifts, Tool Posts, Drill Holders, Cutter Grinding Holders, and Tool Makers' Vises.

ARMSTRONG BROS.

Better Pipe Tools. A complete line, each a better tool with hardened, alloy or drop forged parts wherever they will add to strength or tool life.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
313 N. FRANCISCO AVE. CHICAGO 12. U. S. A.
Eastern Whse. and Sales: 199 Lafayette St., New York 12, N. Y.
Pacific Coast Whse. and Sales Office: 1275 Mission St., San Francisco 3, Calif.

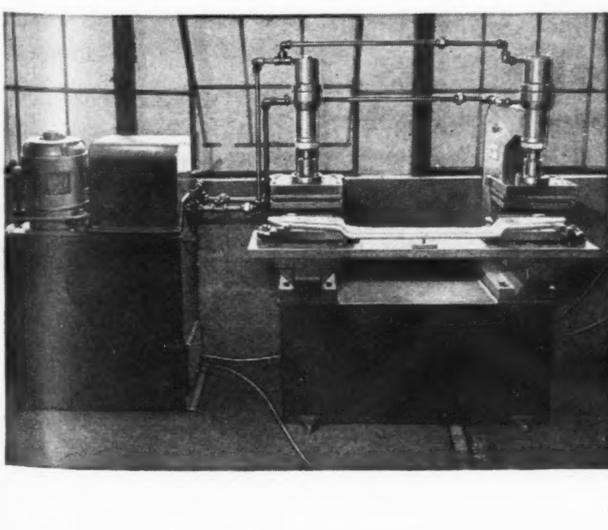


16 holes at the touch of a button...

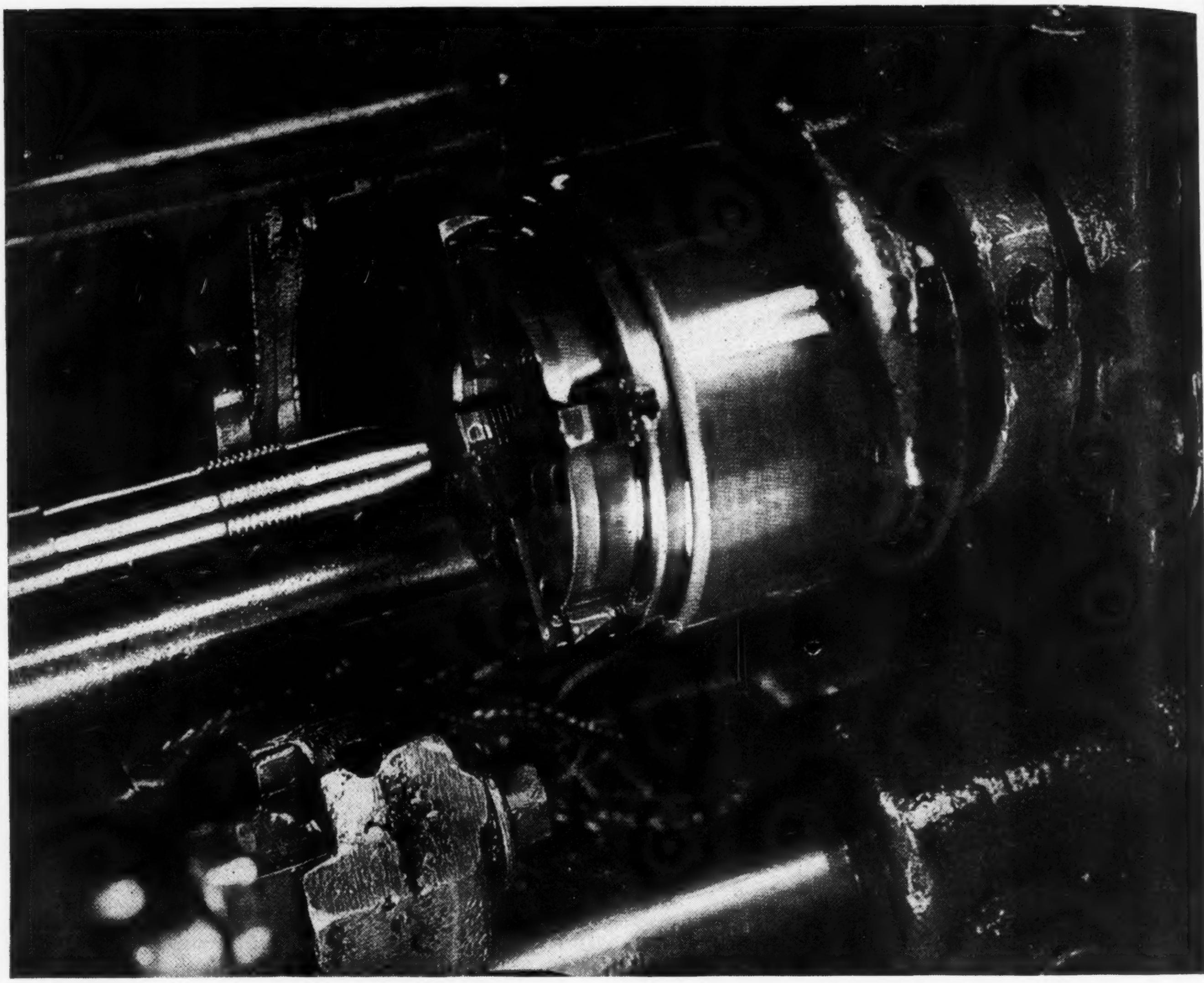
These two "Hy-Power" multiple punching installations at the plant of Precision Castings Company, Inc., illustrate the versatility of Hannifin "Hy-Power" hydraulic punching and riveting equipment. The horizontal multiple punching machine pierces 16 holes of 7/16 in. diameter in a die cast radiator grille bar. The duplex vertical machine also pierces 16 holes—two sets of eight—at the ends of a die cast base bar. Hannifin "Hy-Power" hydraulic multiple punching provides for fast production and easy handling, for the automatic operating cycle is push-button controlled and completed automatically in a matter of seconds. Power is provided by the compact motor driven hydraulic pressure generator.

A wide variety of production punching and riveting can be economically handled with "Hy-Power" equipment, with any number of piercing heads arranged to suit individual requirements. Write for "Hy-Power" bulletins.

HANNIFIN MANUFACTURING COMPANY
621-631 SOUTH KOLMAR AVENUE • CHICAGO 24, ILLINOIS



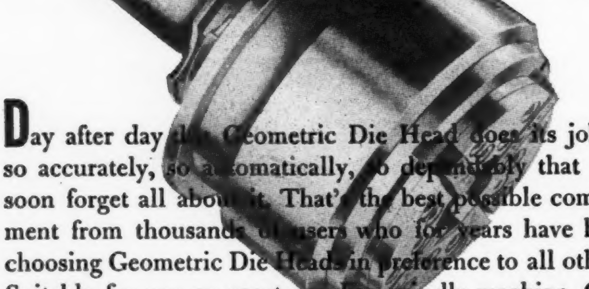
HANNIFIN
"hy-power"
RIVETERS • PUNCHES • PRESSES



A Die Head You Can Forget!

FOR NEARLY EVERY THREADING JOB—A GEOMETRIC!

If you have in mind a particular threading problem, we will be glad to have our engineers give you their recommendations, based on over a half century of specialization in this field. Why not let us send you the latest Geometric catalog?

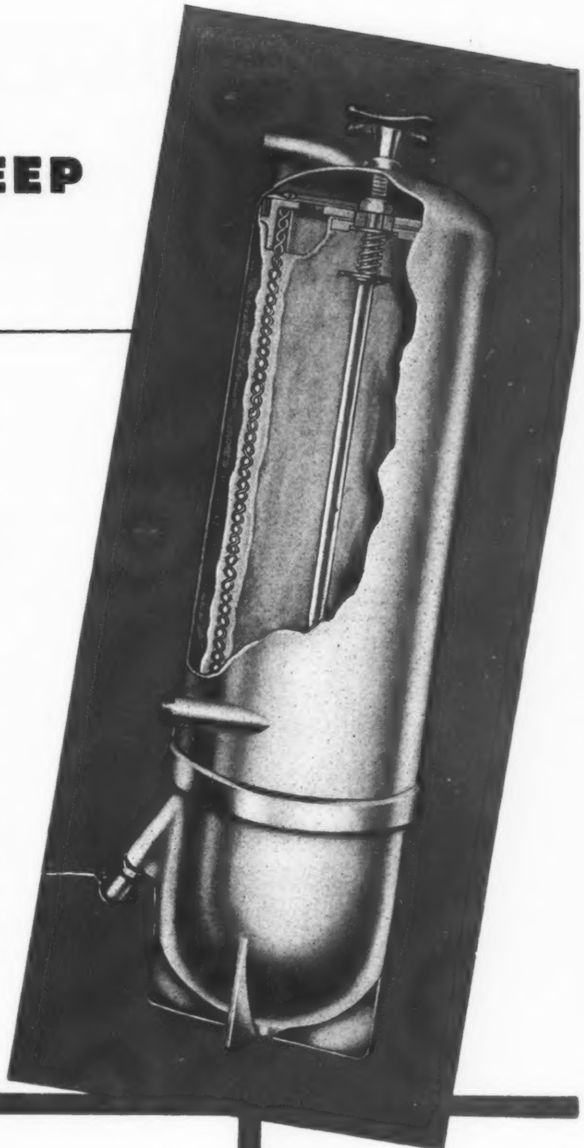


Day after day this Geometric Die Head does its job—so accurately, so automatically, so dependably that you soon forget all about it. That's the best possible compliment from thousands of users who for years have been choosing Geometric Die Heads in preference to all others. Suitable for use on most any live spindle machine, Geometric Die Heads are famous for their long-lived precision. Here this Geometric Style KD Rotary Self-Opening Die Head is cutting a ¾"-16 N. F. thread on a hollow chuck component. Note its compact and rugged design, particularly adapted to multi-spindle automatic screw machines. *Write for complete details about the "Style KD" and other Geometric Die Heads.*

THE
GEOMETRIC
TOOL COMPANY . . NEW HAVEN 15, CONN.

A Division of Greenfield Tap and Die Corporation

THE *NEW*, EASY, LOW-COST WAY TO KEEP COOLANT *CLEAN*



Now you can put a coolant filter on each grinding machine . . . and gain the advantage of *flexibility* . . . at an average cost of only a few cents a week.

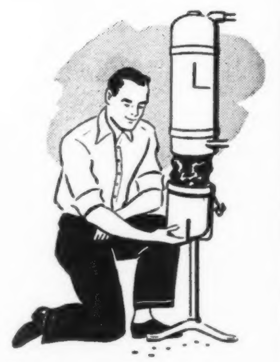
Cuno's new COOLANT-KLEAN is priced less than any comparable filter. The element needs replacement less often . . . new bags are inexpensive . . . coolant stays cleaner longer. Construction is simple and compact.

Typical reports from users say . . . *more dirt collected . . . up to 6 weeks without replacing element . . . "pick-ups" eliminated . . . bags replaced in less than 5 minutes.* (The illustrations show how easy it is to replace the bag.)

COOLANT-KLEAN can be used on any grinder and almost any other machine using coolant or cutting oil . . . is installed quickly, without extra pump, electrical work, plumbing or by-pass. Handles full flow. No filter aid needed. No pre-coating.

Now that unit filtration no longer means high cost, large size and expensive maintenance . . . adopt this more efficient method of cleaning coolant. Send the coupon for COOLANT-KLEAN bulletin.

The Easiest Way to Clean a Filter



Single screw clamp at top loosens sump

Grit emptied from sump

New bag easily slipped over spacer screen

Sump replaced

KEEP FLOW ON "GO" WITH

CUNO

ENGINEERED FILTRATION

Free Bulletin on "Finer Finishes at Less Cost"

CUNO ENGINEERING CORPORATION, 134 South Vine St., Meriden, Connecticut

Gentlemen: Send Bulletin on new COOLANT-KLEAN filter to

Name...

Company...

Address...

Position..

Lengthening the Life of a

"Caterpillar"

DIESEL TRACTOR

There's plenty of power, traction and stamina in this "Caterpillar" D2 tractor. For 13 hours a day, it pulls a 22-inch breaker plow through soggy, virgin marsh land. One important factor in assuring trouble-free service during the long, hard hours of operation is its sturdy, smooth-functioning BCA ball bearings.

Every BCA Ball Bearing is designed to do a specific job . . . carefully engineered to meet exact conditions of speed and load. These bearings increase equipment efficiency . . . extend equipment life. That is why "Caterpillar" and other manufacturers of long lived machinery have used BCA for years.

BCA engineers will be glad to assist you in selecting the bearings that are exactly right for your particular applications.

BCA **BEARINGS COMPANY OF AMERICA**
LANCASTER, PENNSYLVANIA

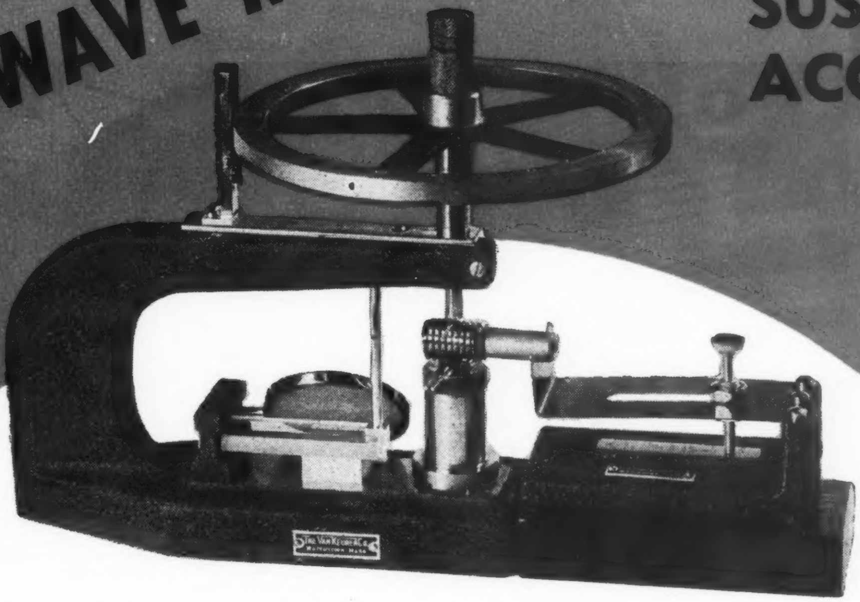
BCA

RADIAL • ANGULAR CONTACT • THRUST
BALL BEARINGS

Van Keuren

LIGHT WAVE MICROMETER

for SUSTAINED ACCURACY



NEW SYSTEM OF ACCURACY—The Van Keuren light wave micrometer is an instrument which has formed the basis for an entirely new method of maintaining high standards of accuracy. No gage blocks are required. Errors from worn gage blocks will not be constantly duplicated in the product.

A calibration chart showing the micrometer screw corrections to .00001" is furnished with each instrument. The new type of hardened and ground precision micrometer screw actually improves with use. Fine workmanship and carboloy wearing surfaces make the instrument accurate and dependable for years of constant service.

CONTROLLED PRESSURE ASSURES UNIFORMITY—By using the sensitivity of light waves the light wave micrometer insures the exact duplication of measuring pressure by any operator. This controlled pressure feature makes it possible to measure hard or soft materials, and for readings to be duplicated by different operators to .00001".

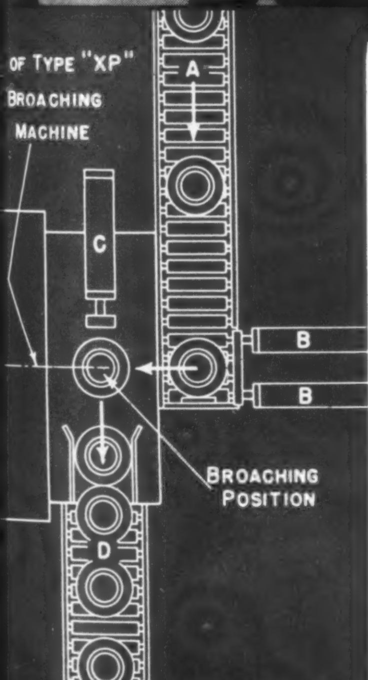
IDEAL FOR SHOP MEASUREMENTS—The light wave micrometer is ideal for making measurements by the 3 wire method, for measuring plug gages, measuring wires, precision parts and shop standards. It is a reference instrument. Forget about comparative measurements with gage blocks—use the light wave micrometer. It is fast, accurate and profitable.

The Van Keuren light wave micrometer is described in catalog No. 33. This book also gives complete tables and simplified formulas for measuring all standard threads, splines and spur gears. **WRITE FOR YOUR COPY!**

THE *Van Keuren* **CO., 178 WALTHAM STREET, WATERTOWN, MASS.**

27th YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Shop Triangles • Carboloy Plug Gages • Carboloy Measuring Wires.



[illegible] view showing operation of Oilgear Automatic Vertical Pull-Down Broaching Machine. Conveyor (A) [illegible] gear blanks into position where [illegible] power cylinders (B) push each [illegible] blank into Broaching Position. Broaching tool then accurately locates and finish broaches blank. Fluid [illegible] Cylinder (C) then pushes finished blank onto roller conveyor (D). [illegible] spontaneous, continuous [illegible] automatic.

Oilgear Vertical Pull-Down Broaching Machine continuously loads, broaches and unloads hypoid bevel gear blanks . . . *automatically*.

This Oilgear Type "XP" Vertical Pull-Down Broaching Machine with automatic loading and unloading mechanism is operating at the Fort Wayne plant of the Spicer Mfg. Co. Its job is to finish broach holes in the forged steel hypoid bevel drive gear blanks fed to it from a boring machine by means of a conveyor.

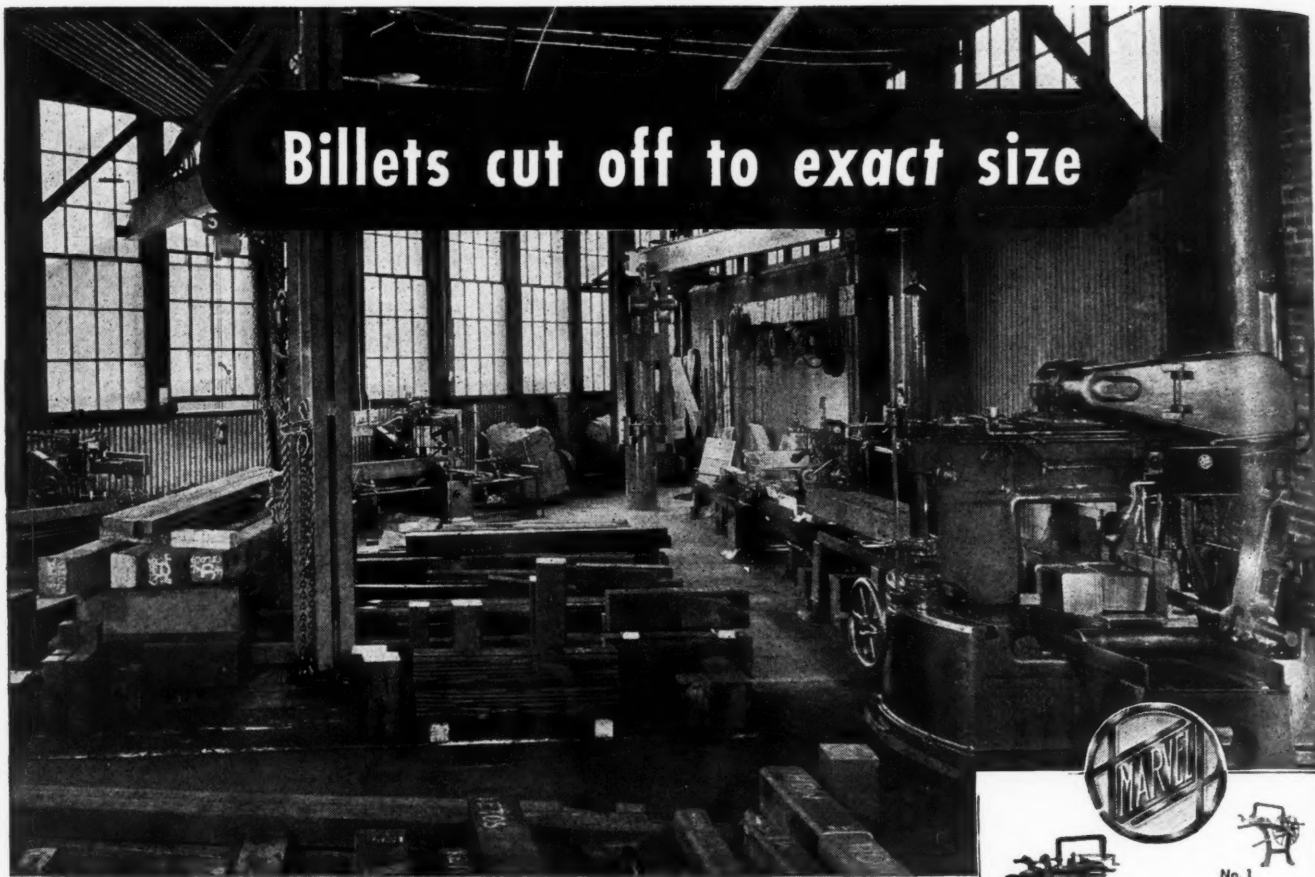
Two fluid power cylinders remove the blank from the conveyor and place it in the broaching position on the machine. As tool descends, shank accurately locates blank. Tool is pulled downward to broach part. Another fluid power cylinder pushes the finished part onto a second conveyor which takes it away. There's no manual loading—no levers or buttons to operate—no manual threading of part over tool shank—no cautious centralizing of part by hand—no manual handling of tool—no manual unloading. All operations are automatic, continuous and unattended.

The Oilgear Automatic Broaching Machine removes approximately .020" of stock on the diameter and produces 225 finished ring gear blanks per hour. Other sizes of bevel gear blanks can be broached on the same machine by changing the broaching shells on the tool steel bar.

If you are looking for faster production and lower costs, investigate Oilgear Broaching Machines, either vertical or horizontal for every type of internal and external broaching. They provide high broaching and return speeds, infinitely adjustable. They make more efficient use of electric power hence require smaller motors. They make more efficient use of oil medium hence require much smaller reservoirs. They provide manual, semi-automatic and full automatic control at no extra cost. THE OILGEAR COMPANY, 1312 W. Bruce St., Milwaukee 4, Wis.

M

Oilgear Fluid Power



Any Quantity cut-off automatically

These MARVEL Saws are money makers for this modern forge shop in many ways. (1st) they cut off billets for a small fraction of the cost of cutting-off with a hammer. (2nd) these billets are so accurate in size that they exactly fill the dies with no excess fin, not only simplifying trimming and finishing, but getting extra billets from many bars. (3rd) they keep all hammers busy on *production* work for these "world's fastest" saws can keep ahead of any schedule. (4th) they reduce cutting-off labor costs to an absolute minimum. It takes only one operator and a helper to keep all of these saws running because all but the No. 18 Giant Hydraulic Saw (at the right) are *automatic*—feed measure, and cut-off identical billets; requiring no more attention than automatic screw machines.

Your local MARVEL Sawing Engineer will gladly call and explain how you can add these five extra profits to your forge operation.

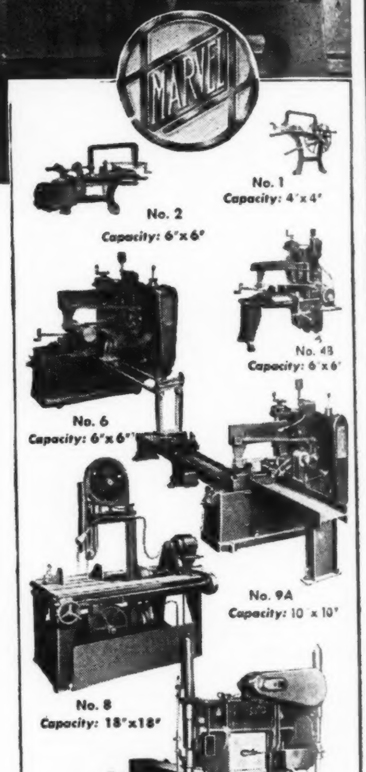
ARMSTRONG-BLUM MFG. CO.

"The Hack Saw People"

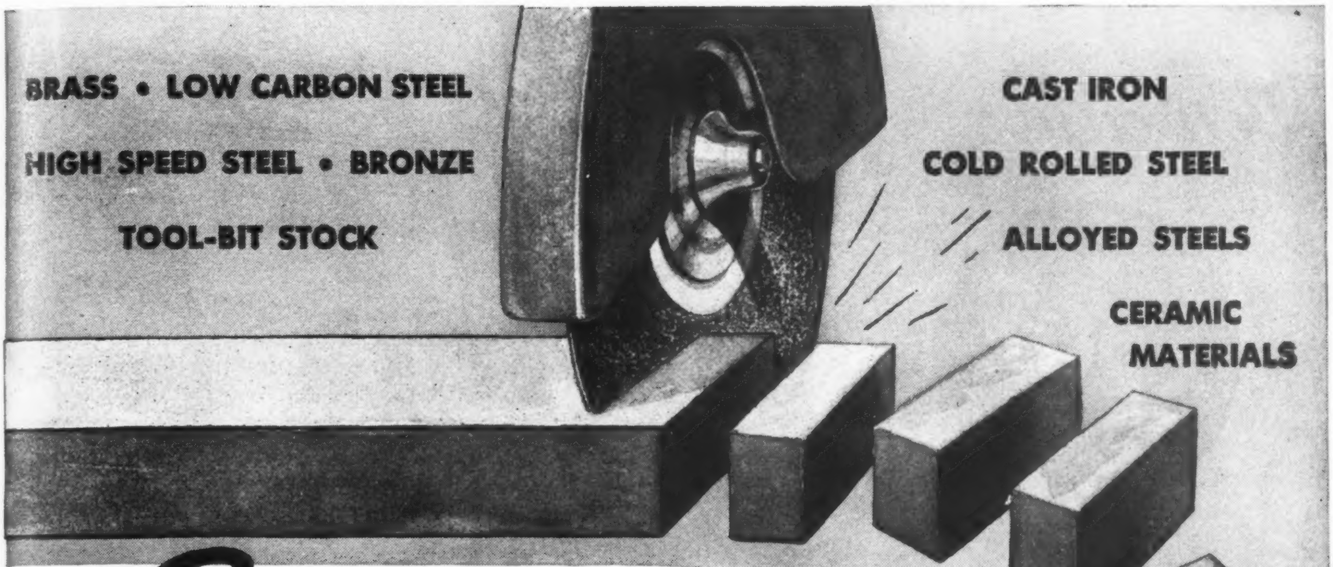
5700 BLOOMINGDALE AVENUE CHICAGO 39, U.S.A.

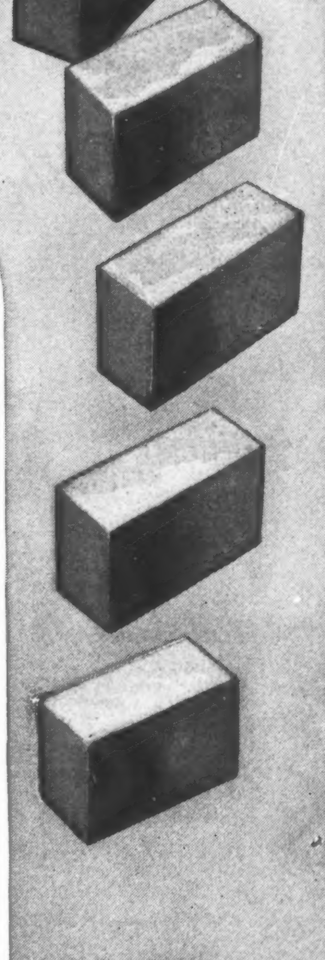
Eastern Sales Office: 225 Lafayette St., New York 12, N. Y.

MARVEL SAWS



MARVEL SAWS





Electro HIGH SPEED CUT-OFF WHEELS

It does take a bit of believing, no doubt about it, to think that "grinding" wheels can be made to cut with knife-like speed. But, in "Electro" HIGH SPEED CUT-OFF WHEELS, we achieved amazing strength in wafer thinness. We perfected a cutting *edge*. We reduced cutting-off time from minutes to seconds. Tell us that we may and we'll show you *on your jobs*, on anything from tool-bit stock to ceramic materials, how Electro high speed cutting-off surpasses all other methods for speed, precision and safety.

In advance of this demonstration, we invite you to send for our new Grinding Wheel Manual, illustrated in full color and technically informative as to components, structure, selection, and operation. No wonder it is the most talked-of catalog in industry! Write for your copy. We'll send it free and post-paid.

Electro TRADE MARK SINCE 1919

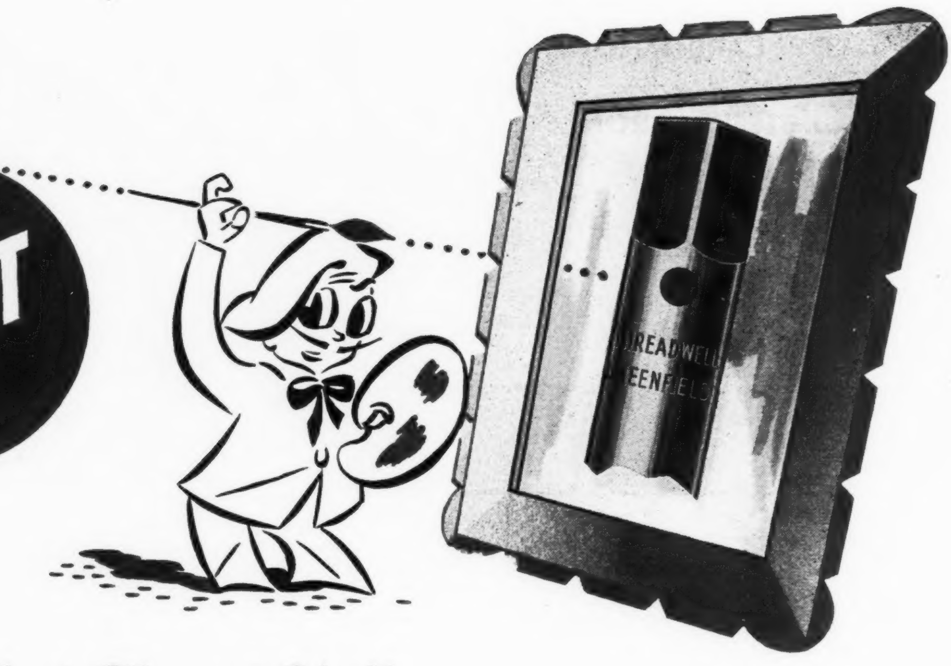
Electro REFRACTORIES & ALLOYS CORPORATION

MFRS. • REFRACTORIES • CRUCIBLES • STOPPERS • ALLOYS • GRINDING WHEELS

344 DELAWARE AVENUE — BUFFALO 2, NEW YORK

You can

SPOT



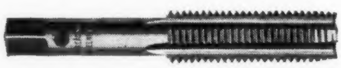
TAPS *That Thread Well*

by the THREADWELL DOT

Threadwell "*i-dot-ification*"—*red* dot for cut thread, *white* for commercial ground, *blue* for precision ground—is more than a quick, convenient means of identification for use and a positive assurance you get the tap you pay for. It identifies the tap as a product of *Threadwell* precision craftsmanship; a tap that has met the most exacting standards of testing and inspection; a tap that will give you better threads and more threaded holes whether you're tapping steels, cast iron, alloys or plastics.

Threadwell is a good name to remember. Look for the name and the color dot on every high speed tap. *Threadwell* Taps are available through a leading Mill Supply Distributor in your locality. Let us put him in touch with you.

DOT'S NOT ALL!



Threadwell Taps have

COLD-TEMPER—treated at 120° below zero for extra toughness without brittleness.

TAP-CAPSULE—in individual transparent plastic tubes that protect ground-threads and permit quick selection of type and size before unwrapping.

GREASELESS RUST-PROOFING—by an exclusive *Threadwell* process that keeps the tap clean and dry, ready for instant use.

Remember. Threadwell COLD-TEMPER I-DOT-IFIED, TAP-CAPSULED, RUSTLESS Taps *cost no more* than any other high speed taps.

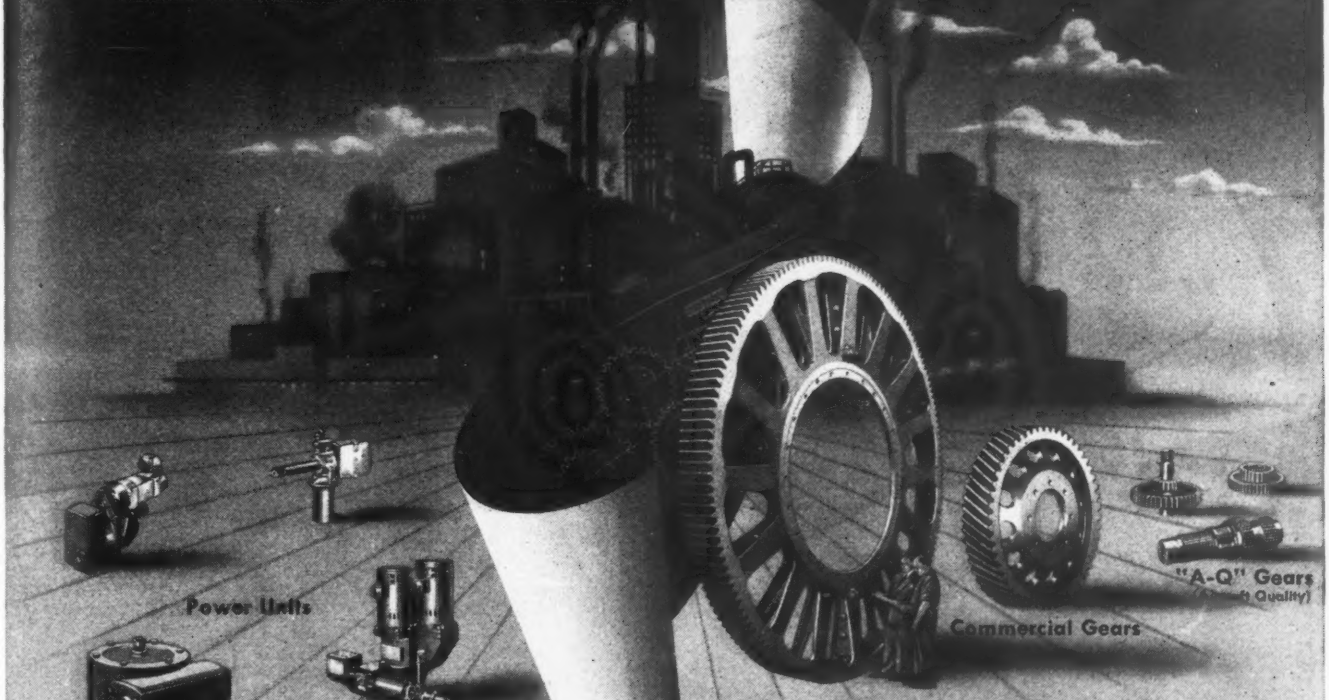
DISTRIBUTORS IN LEADING INDUSTRIAL CENTERS THROUGHOUT THE UNITED STATES AND THE WORLD

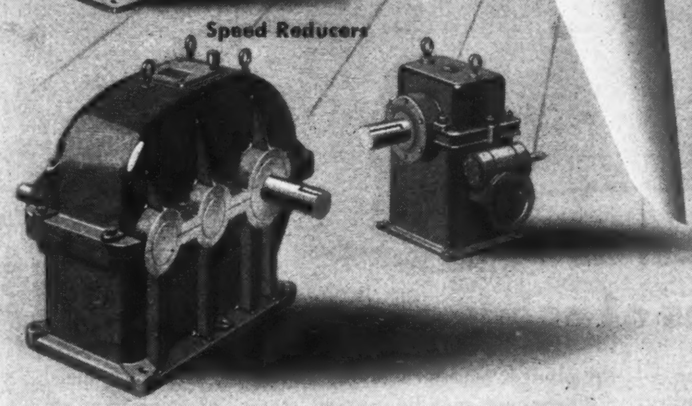
Threadwell
SINCE 1902
"TAPS OF DISTINCTION"

THREADWELL TAP AND DIE COMPANY • GREENFIELD, MASSACHUSETTS, U. S. A.

CALIFORNIA OFFICE, THREADWELL TAP & DIE CO. OF CALIF., 1322 SANTA FE AVE., LOS ANGELES 21

If You Transmit Power...
call on FOOTE BROS.





What is your particular need in power transmission?

Do you need gears—spur, helical, worm or bevel, of cast iron, steel, bronze or composition? Foote Bros. has been making gears for almost a century—giants 20 feet in diameter to midgets you can hold in one hand.

Do you need speed reducers for the machinery in your plant or the machines you make? Foote Bros. has a complete line of helical and worm gear reducers as well as flexible couplings.

Have you a problem where extreme speeds, compactness, efficiency, or low noise level are important? Foote Bros. "A-Q" (aircraft quality) gears are nearest to perfection.

Are you faced with the need of controlling or applying linear or rotary motion continuously or intermittently? Do you need an actuator to operate on an exact time cycle or control motion within close limits? Foote Bros. Power Units are the answer. They may be engineered to meet unusual space, weight or special requirements.

Wide experience, broad line and complete facilities make Foote Bros. your No. 1 source for power transmission equipment.

A recently issued bulletin on Power Units giving complete engineering data on "packages of power" will be sent on request. Also available is a bulletin on Aircraft Quality Gears. Mail the coupon.

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION, 4545 S. Western Blvd. • Chicago 9, Ill.

Foote Bros. Gear and Machine Corporation
Dept. P, 4545 S. Western Boulevard, Chicago 9, Ill.
Please send me Bulletins on:
☐ Power Units ☐ Aircraft Quality Gears.

Name .... *Position* ....

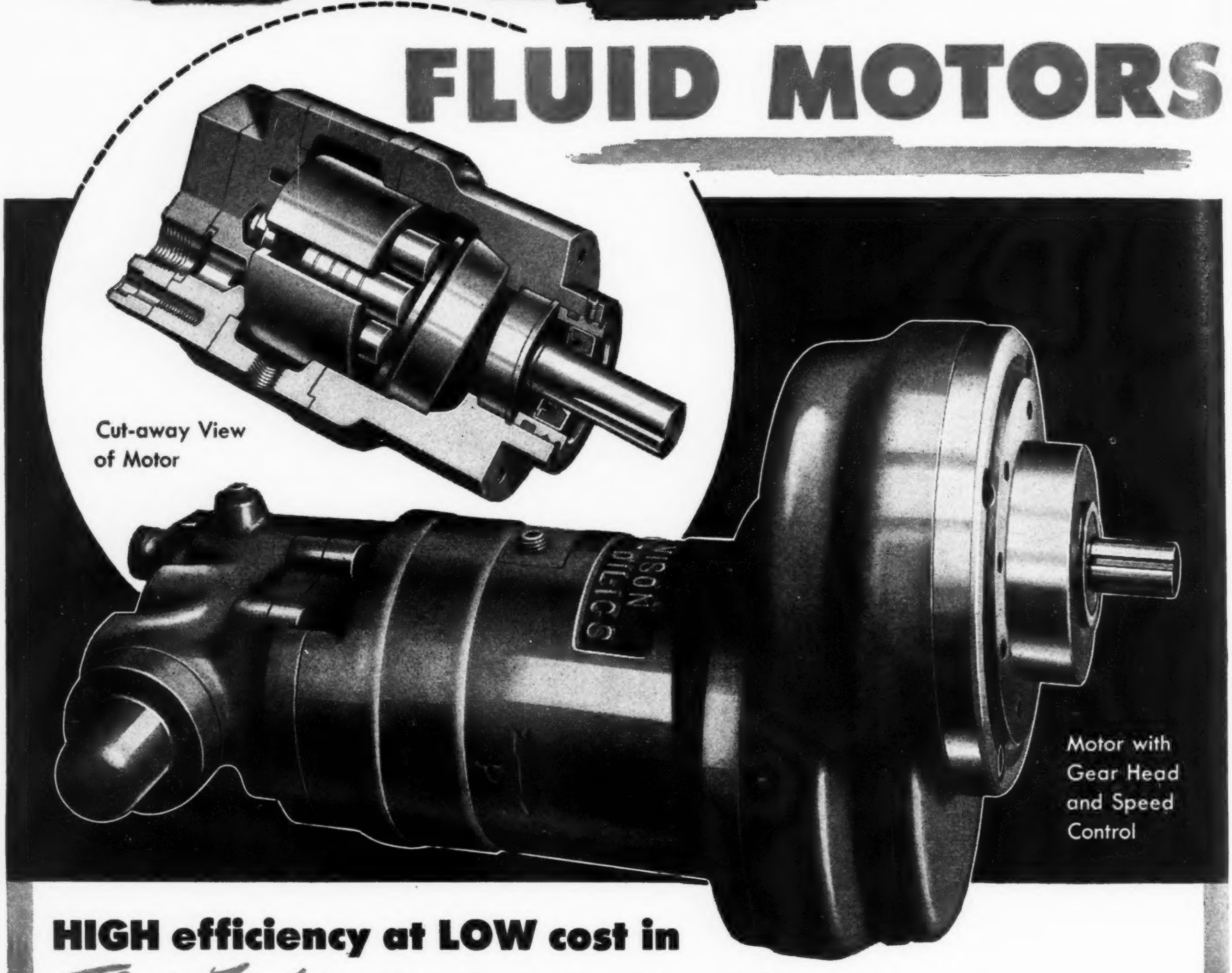
Firm ....

Address ....

City .... *State* ....

DENISON HydrOILic

FLUID MOTORS



HIGH efficiency at LOW cost in *Fluid Motors* for dozens of needs..

WHEREVER rotary power can be applied, Denison HydrOILic Fluid Motors offer freedom from shock-load problems—stepless speed variation—instant speed-up for rapid-traverse needs, and many other advantages!

An exclusive feature of these fluid motors is the unique "floating drive" construction. It provides *constant pressure contact* between the driving and driven elements *without mechanical linkages of any kind!* Sudden starts, stops or reversals can't cause distortion or breakage; destructive backlash or inertia is eliminated.

Equipped with speed control, the motors may be preset to operate constantly at any speed within their capacity, and that speed may be increased or reduced as desired while the motor is in operation.

Quick speed-up for rapid-traverse needs is provided by a plunger device interlocked with the speed-control valve. It permits instant acceleration from any pre-set speed to full-speed operation, for any desired interval. Releasing the plunger causes the motor to resume its pre-set speed.

The motors may be stopped, started or reversed at any time without affecting their speed setting or the operation of the speed-up control. Motors are also fully self-starting from any stopped position. The plunger may be activated by lever, cam, or linkage arrangement (not included with speed control valve assembly).

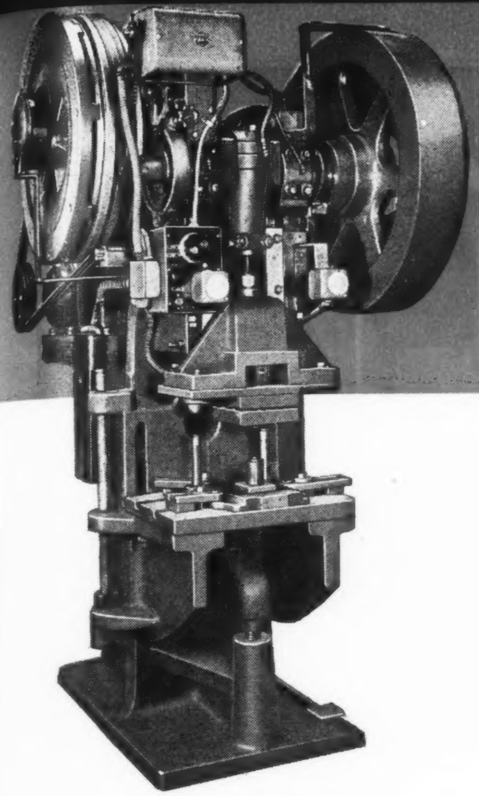
The motor itself operates in a bath of oil, and normal slippage provides continuous circulation of oil through the gear-box—the entire unit is completely self-lubricating. Helical gears assure smooth, quiet operation and minimum wear.

Denison HydrOILic Fluid Motors are compact, ruggedly-built units in 3 and 5 h.p. sizes, available with or without speed-control valve and gear-head drive. Gear ratios—1:3, 3:1, 1:1.5, 1.5:1. Write for complete details!

* * *

DENISON EQUIPMENT in APPLIED HydrOILics

The Denison Engineering Company, 1152 Dublin Road, Columbus 16, Ohio.



Dynamatic Drive Installed on Punch Press

DYNAMATIC

ELECTRO-MAGNETIC

DRIVES, POWER COUPLINGS, BRAKES AND OTHER DEVICES

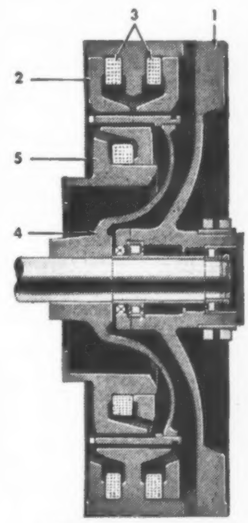
Provide

- ★ **Variable Speed from Constant Speed Source**
- ★ **Constant Speed from Variable Speed Source**
- ★ **Smooth, Full-Torque Starts**
- ★ **Cushioned Stops**

Utilized as a variable speed drive, power coupling, slipping clutch, or brake, the Dynamatic principle has a wide range of applications in many industries. It furnishes a simple, compact, frictionless means of power application which is under instantly responsive control. Sizes range from the tension control on a non-backlash casting reel to an 18,000 horsepower drive for a wind-tunnel blower.

The construction of Dynamatic devices is extremely simple. Basically, all Dynamatic devices consist of two rotors, one operating inside of, but not touching the other. One of the rotors is an electro-magnet. Either of the rotors may be connected to the driving member, or to the driven member. Direct current field coils, located in one rotor, produce eddy currents in the other rotor, which in turn exerts a pull on the latter. The amount of slippage between the two rotors is simply and accurately controlled by varying the direct current applied to the field. Electronic means can be used for governing or controlling the speed of the output rotor to a fine degree of accuracy. Efficiency in commercial applications is normally between 95% and 97% at full speed, although, when desirable, slip can be reduced to 1%.

Dynamatic devices can be applied to any shaft in any type of machine to transmit motion from one rotating member to another without mechanical contact, without friction, without shock, and under complete control. Inquiries are invited.



1. Flywheel 2. Main Field 3. Coils 4. Rotor 5. Brake Field

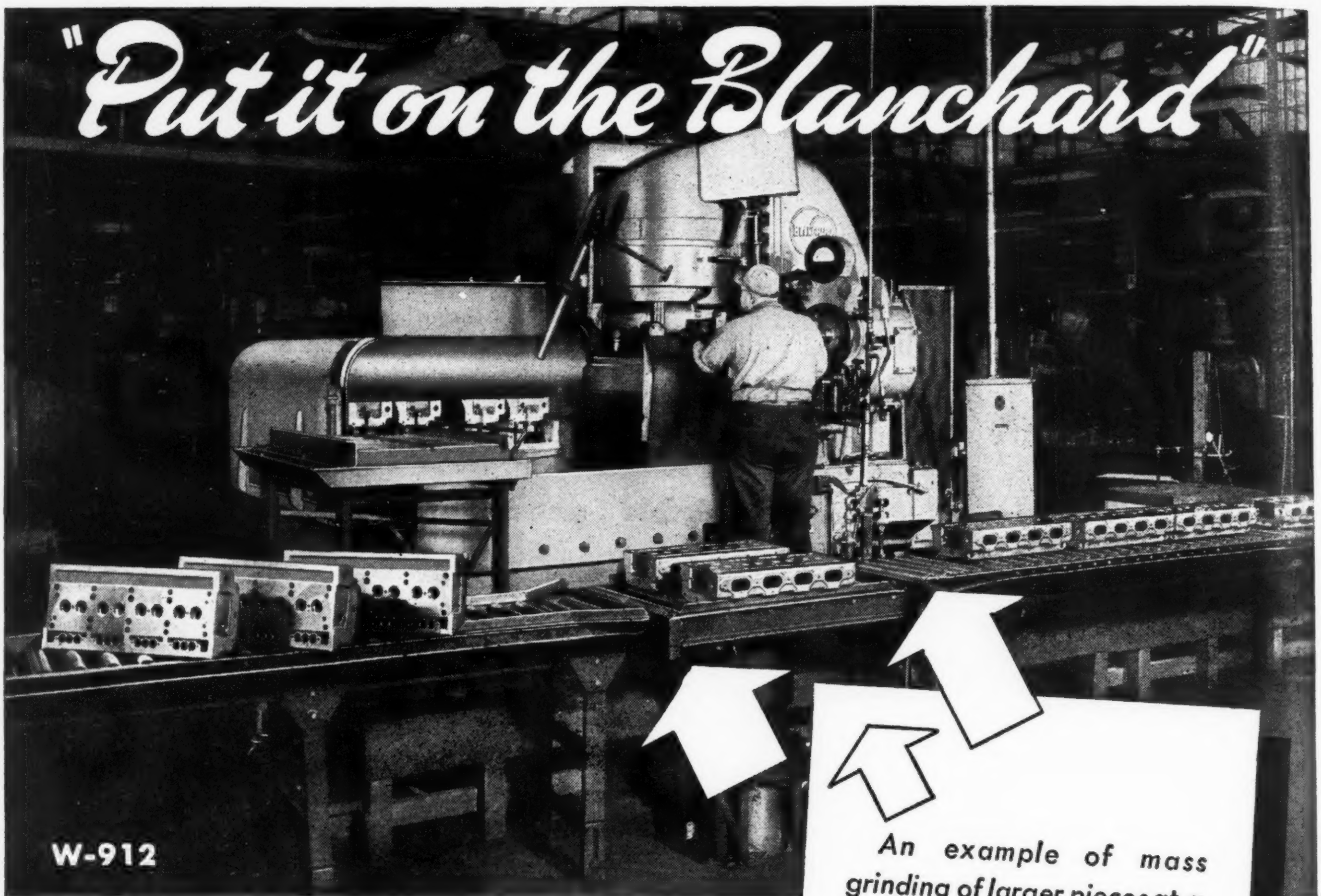
Typical Dynamatic Applications

- Electric Shovel Drives
- Oil Well Drawworks Brakes
- Punch Press Drives
- Dynamometers
- Adjusto-Spede Motors
- Vehicle Drives
- Vehicle Brakes
- Centrifugal Pump Drives
- Take-up Reels
- Air Conditioning Unit Drives
- Blower Fan Drives
- Air Tunnel Blower Drives
- Automotive Fan and Pump Drives
- Automotive Accessory Drives
- Lift Truck Drives

DYNAMATIC CORPORATION • KENOSHA WISCONSIN

Subsidiary of **EATON MANUFACTURING COMPANY**

General Offices: CLEVELAND, O. *Plants:* CLEVELAND • MASSILLON • DETROIT • SAGINAW
BATTLE CREEK • MARSHALL • LAWTON • VASSAR • KENOSHA • WINDSOR (CANADA)



An example of mass grinding of larger pieces at a greater profit.

Four diesel cylinder heads are held on a 60″ magnetic chuck of a No. 27 Blanchard Surface Grinder. The material is cast iron. Each head measures $25\frac{1}{2}'' \times 10\frac{1}{4}'' \times 5\frac{3}{16}''$.

Average stock removal per side is .005″. One side is ground flat within .001″.

Production is 27 pieces (27 surfaces) per hour. This includes loading and unloading time.

THE MOST PROFITABLE WORDS IN FLAT SURFACE GRINDING

Whatever type of flat surface grinding your parts may require—be it simple "cleaning up"—or rough grind *and* finish grind in one operation—or very flat surfaces with a fine finish and held to close limits—*there is no more profitable method*, in practically all cases, than to "Put it on the Blanchard."

Blanchard's specialization in grinding flat surfaces assures you the most profitable flat surface grinding machines you can buy.

IF YOU MACHINE FLAT SURFACES . . . bring your problems to The Blanchard Machine Company.

Send for your free copy of "Work Done on the Blanchard", third edition. This new book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

BLANCHARD

The **BLANCHARD** MACHINE COMPANY

64 STATE STREET, CAMBRIDGE 39, MASS., U. S. A.

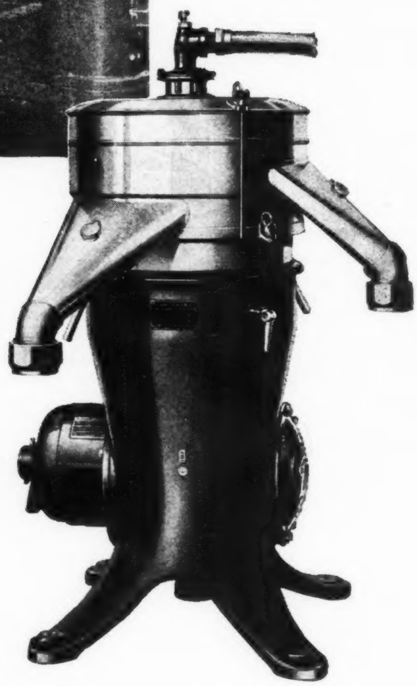

Overwhelming evidence
FOR THE SELECTION OF
H & G Insert Chaser DIE HEADS
REASONS STATED BY USERS*
SEATTLE "More economical, more uniform hardening."
SAN FRANCISCO "Best adapted for B & S automatics."
LOS ANGELES "Long chaser life and good construction."
SAN DIEGO "Interchangeability of chasers for different types of die heads."
FOND DU LAC "Low investment in chasers."
GALVESTON "Best for small high speed automatics."
CLEVELAND "Large thread capacity for small body. Ease of regrinding chasers."
CINCINNATI "For close to shoulder threading."
DALLAS "Have better luck in holding tolerances."
BIRMINGHAM "Adaptability to wide range of materials and machines."
DAYTON "Hold size better. Threads straight and true."
PITTSBURGH "Prompt, cooperative service."
TORRINGTON "Retains accuracy longer."
NEW HAVEN "Accuracy, performance, economy."
HARTFORD "More threads per grind."
WORCESTER "Low price chasers — quick to set — uniform high quality threads."
BEDFORD "Continued accuracy on long runs."
H&G Insert Chaser DIE HEADS
* Based on impartial survey.
H&G SPEED CALCULATOR
Foremen, Set-up Men and Engineers find the H&G Speed Calculator based on a circular slide rule formula very useful for arriving at proper feeds and speeds. It eliminates figuring; is a valuable time saver. FREE when requested by users of die heads. Otherwise 15c.
SEE H&G CATALOG IN SWEET'S FILE
H&G INSERT CHASER DIE HEADS
Free
BULLETIN 10
Briefly describes the famous H&G Insert Chaser Die Heads, available in a wide range of sizes and styles for all machines on which threads are cut.
THE EASTERN MACHINE SCREW CORPORATION
23-43 Barclay Street New Haven 6, Conn

Don't let your press be damaged by condensate

WATER can do a lot of damage to presses and other hydraulically - operated mechanisms. Condensate in hydraulic oils can rust pumps, valves and controls, can cause leather seals to harden. Dirt and sludge, too, can score highly finished surfaces and make costly repairs necessary.

De Laval Oil Purifiers save hydraulic mechanisms in presses and other machines by providing a ***continuous*** supply of oil, free from dirt and water—oil that can be used with perfect safety indefinitely in any hydraulic application.

Because they are wholly mechanical in action, operating by centrifugal force, De Laval machines discharge oil that is uniformly clean. There is no lessening of efficiency during the run of the Purifier.

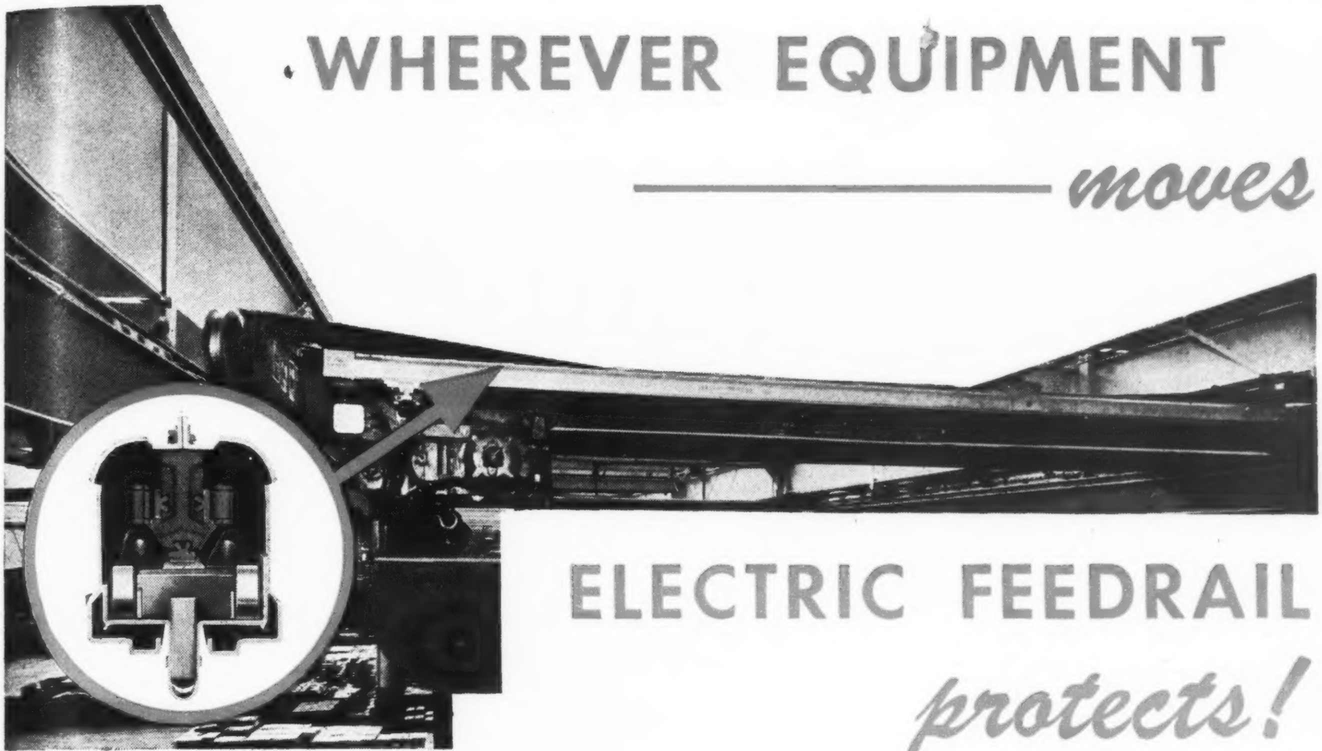


The De Laval Oil Purifier above is the type generally used to purify hydraulic oil, cutting oil and other factory oils. Various other models are available for specific purposes.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

Save more than the Oil with DE LAVAL

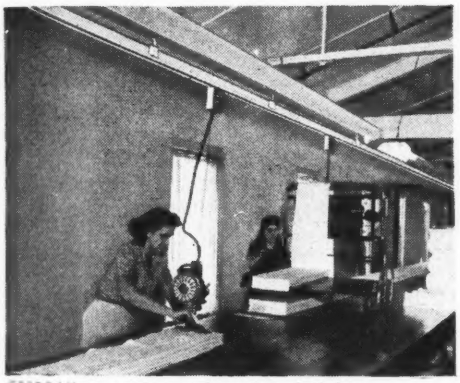
PURIFIERS and CLARIFIERS
FOR FACTORY OILS



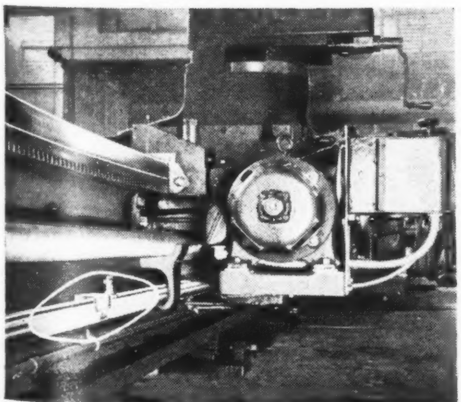
FEEDRAIL "100" on crane

WHEREVER EQUIPMENT
moves

ELECTRIC FEEDRAIL
protects!



FEEDRAIL on cutting and moving cloth laying machine



FEEDRAIL on machine tool

Whenever you see exposed wires on a crane system, wires on the floor or awkward motions of portable tool operators — think of FEEDRAIL.

CRANES AND HOISTS

Electric Feedrail is an enclosed bus bar system having movable trolleys that make contact with the bus bars at all times. It is polarized, fused and grounded and each section carries the Underwriters' Label.

FEEDRAIL is protected against dust, mechanical injuries and mechanical shorts. It is furnished in assembled sections and curves. Also available for Slide Switches and transfers. Easy to install, inspect and service.

PORTABLE TOOLS

FEEDRAIL not only feeds but also supports all types of portable tools which may be readily disconnected by means of fused EVER-LOK connectors.

TEST RACKS

or any electrical equipment that has to be moved or rearranged to accommodate new production layouts is best served by FEEDRAIL.

ASK FOR FEEDRAIL CATALOGS GENERAL No. 15,
NEEDLE TRADES No. 16, MACHINE TOOL No. 17

14

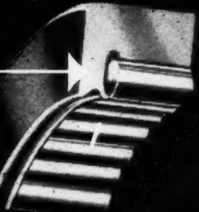
ELECTRIC FEEDRAIL

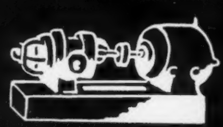
FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company

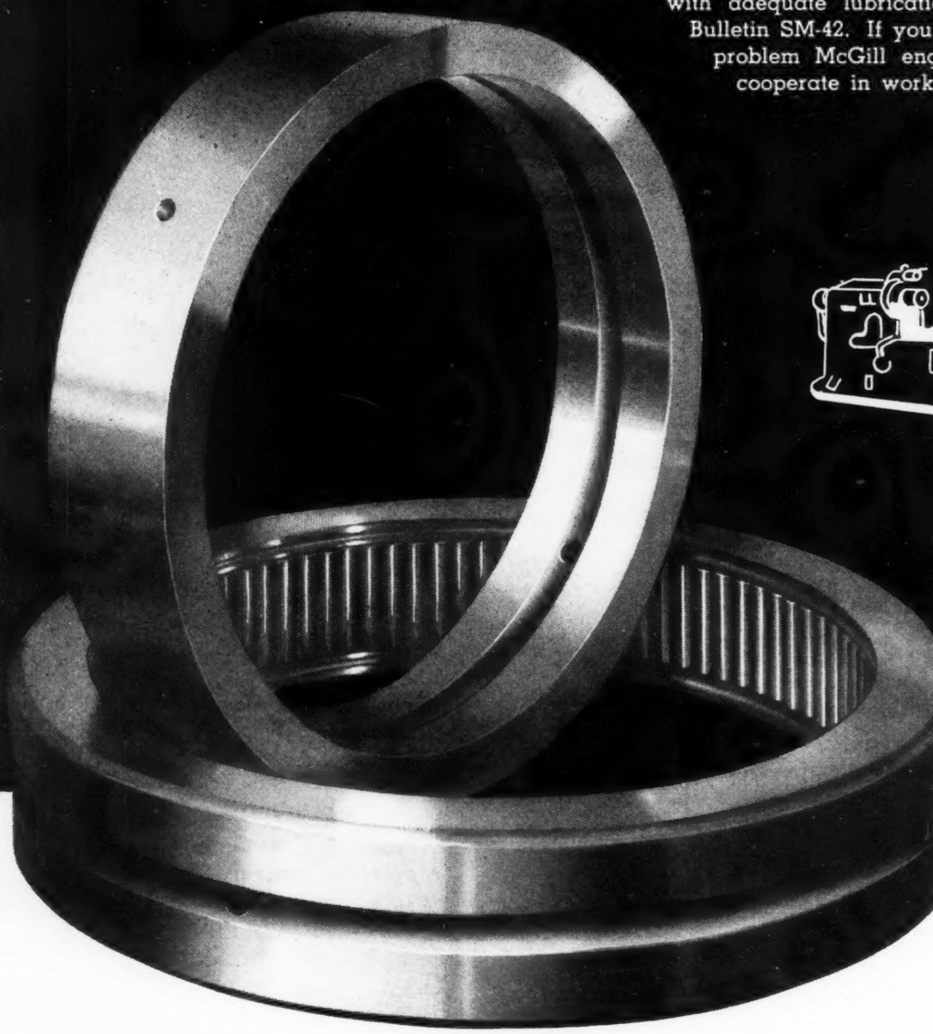
125 BARCLAY STREET • NEW YORK 7, N. Y.

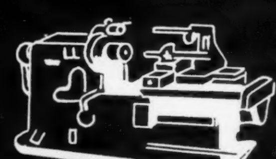
McGILL

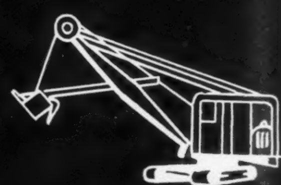
SOLIDEND  MULTIROL *Bearings*



Designed as a self-contained unit, with races and rollers made from through-hardened high-carbon chrome steel, there are no loose parts to warp or break. The solidend shoulder construction and retaining lip, built integral with the outer race, hold the rollers, eliminating any possibility of the bearing coming apart during installation or operation. Rounded end, full length rollers give greater load carrying capacity, and close tolerance in construction, increases the overall efficiency. Where it is necessary to conserve radial space the bearing can be used without the inner race and the bearing mounted directly on the shaft. Provision for incidental thrust is provided along with adequate lubrication facilities. Write for Bulletin SM-42. If you have a special bearing problem McGill engineers will be glad to cooperate in working out a bearing to fit.







FOR ALL TYPES OF INDUSTRIAL EQUIPMENT

McGILL MANUFACTURING CO., INC.

MANUFACTURERS OF BALL AND ROLLER BEARINGS — VALPARAISO, INDIANA

GAGES

THAT "FALL IN"...

RETAIN THEIR ORIGINAL *Accuracy* LONGER

The quality of precision finished holes made to close tolerances is easily and accurately controlled at the machine or bench when P&W "Pilot" Plug Gages are used. When the machine operator desires to check the work-piece, the "Pilot" Plug is presented lightly at any angle to the hole. Without binding, the gage "falls in" the hole and the operator checks the fit.

The P&W "Pilot" feature prevents injury to the edges of precision finished holes and protects the gaging surface of the plug. Pilot Gages give longer gage-life and reduce the cost of gaging.

They are carefully ground and precision lapped to XX, X, Y, or Z tolerances and are available in tool steel, chromium plate, cemented carbide or Norbide.

Write on your company letterhead to the address below or consult your nearest P&W Branch Office for further information on how to control the quality of precision finished holes with P&W "Pilot" Plug Gages.

PRATT & WHITNEY

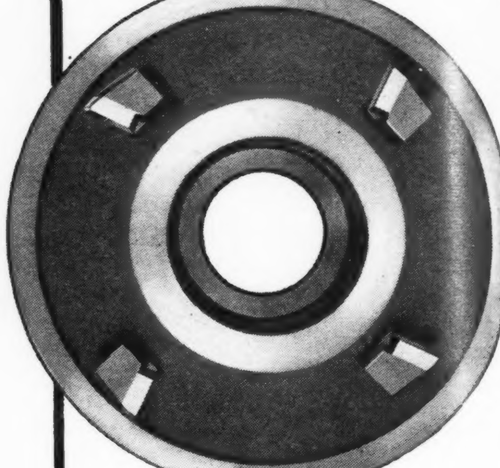
Division Niles-Bement-Pond Company

WEST HARTFORD 1 • CONNECTICUT

Birmingham • Boston • Chicago • Cincinnati • Cleveland • Detroit • Los Angeles • New York • Philadelphia • Pittsburgh • Rochester • St. Louis • San Francisco

ANOTHER NEW LOVEJOY

CARBOLOY TIPPED
CEMENTED CARBIDE
TOOL-BIT-TYPE



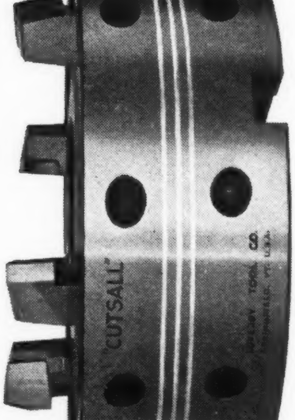
"CUTSALL" STEP TOOTH MILL

Here's another new "Cutsall" to cut your milling costs. The staggered teeth give the results of four single fly cutters—with metal removing ability that will outstrip anything you've ever tried.

Lovejoy "Cutsall" mills have large Carboloy tool-bit-type blades that can be supplied for right- or left-hand cutting, *with the same housing*. The blades can be ground easily to obtain positive or negative rake. The rear on each blade is tapered so that fine adjustment is easily made with rear set screw—front set screw securely locks the blade in the housing. (See phantom view, below.)

"Cutsall" face and step tooth mills are available in 6", 8", 10" and 12" sizes—*all take a single blade size*—all will give performance unmatched by any other mills. Write for details and prices.

- POSITIVE and NEGATIVE RAKE, RIGHT and LEFT
- HAND in ONE HOUSING
- FINE BLADE ADJUSTMENT
- EXTRA LARGE CARBOLOY TIPS



LOVEJOY
TOOL COMPANY, INC.
Springfield, Vermont, U. S. A.

Improved

"MAXI"

Surface Treated Taps

You can again get "MAXI" surface treatment on "Greenfield" Taps at no extra cost.

"MAXI" was a pre-war champion when it came to tap performance. Today's "MAXI" is *better than ever.* Intensive research in "Greenfield's" metallurgical laboratory during the war has produced better formulas for surface treatment.

WHAT IS "MAXI" FINISH?

It is a heat treatment applied to High Speed Steel tools which imparts a surface hardness greater than that of an untreated tool. This surface is applied by a chemical bath. It does not affect the basic character of the metal nor the size of the tap.

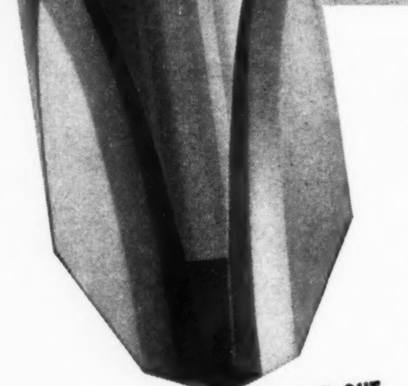
COSTS NO MORE!

You can get a "MAXI" surface treatment on any "Greenfield" HIGH SPEED tool, regular or special, in any size at no additional cost. Simply add the word "MAXI" when ordering.

GTD

GREENFIELD

GREENFIELD TAP and DIE CORPORATION
GREENFIELD • MASSACHUSETTS



AMERICAN PHILLIPS SCREWS are "FIRST MATES" Cost-wise

. . . BOTH TO BOAT-BUILDERS AND OWNERS

In shipyards (as in automobile plants, refrigerator factories — *or what's yours?*) American Phillips Screws deliver these special savings: Swift, sure-handed handling. Automatically straight driving. Protected, unspoiled work-surfaces. More and better work done far more easily. All of which translate into TOTAL TIME-SAVINGS AS HIGH AS 50%!

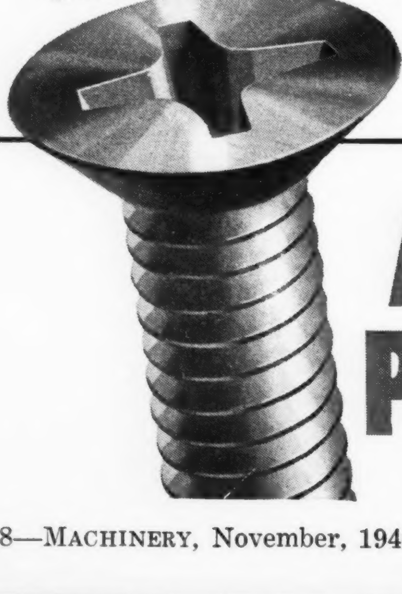
And American Phillips savings reach straight through to the buyer of the boat. For these screws resist corrosion, withstand vibration, remove screw-driving from his maintenance work, help to keep his craft always trim, tight, and shipshape.

You can steer by this: American Phillips Screws are profitable not only production-wise. They're potent sales promotion, as a mark of quality construction . . . and they're sound sales-protection, too. *You* can get these same production and sales advantages in American Phillips Screws in any type or metal (see below) for any fastening requirement. Write.

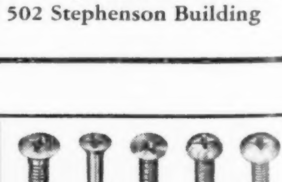
4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

Chicago 11: 589 E. Illinois Street *Detroit 2:* 502 Stephenson Building



AMERICAN PHILLIPS *Screws*

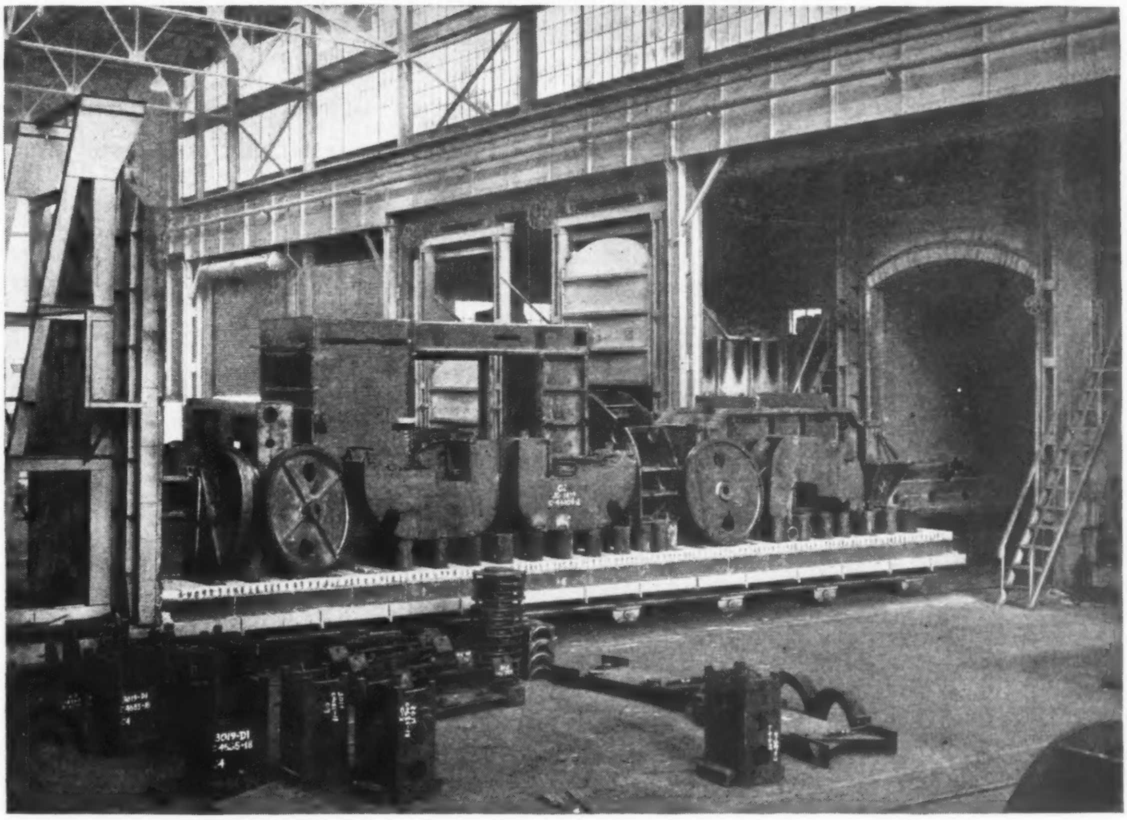


ALL TYPES
ALL METALS: Steel, Brass, Commercial Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)

Warco PRESSES

WELDED STEEL PRESSES

(FULLY STRESS RELIEVED)



"Baking" Strength into the Unity of Metals

● The inherent stiffness of steel plate is 2½ times that of gray iron castings and 1½ times that of Meehanite or high test castings.

Warco press engineers have capitalized on this advantage in designing and building the advanced line of Warco welded steel presses.

In actual construction, they go even further to help assure the maximum rigidity so necessary to long die life.

All welded parts are "baked" at 1150 degrees F for a pre-determined period of time in one of our three custom built annealing furnaces, to give additional strength to the perfect union of metals in the weldments.

This stress-relieving of weldments, though a routine step in fabrication of Warco presses, is vitally important. It virtually eliminates locked up stresses that might otherwise build up and contribute to the hazard of misalignment from overload in service.

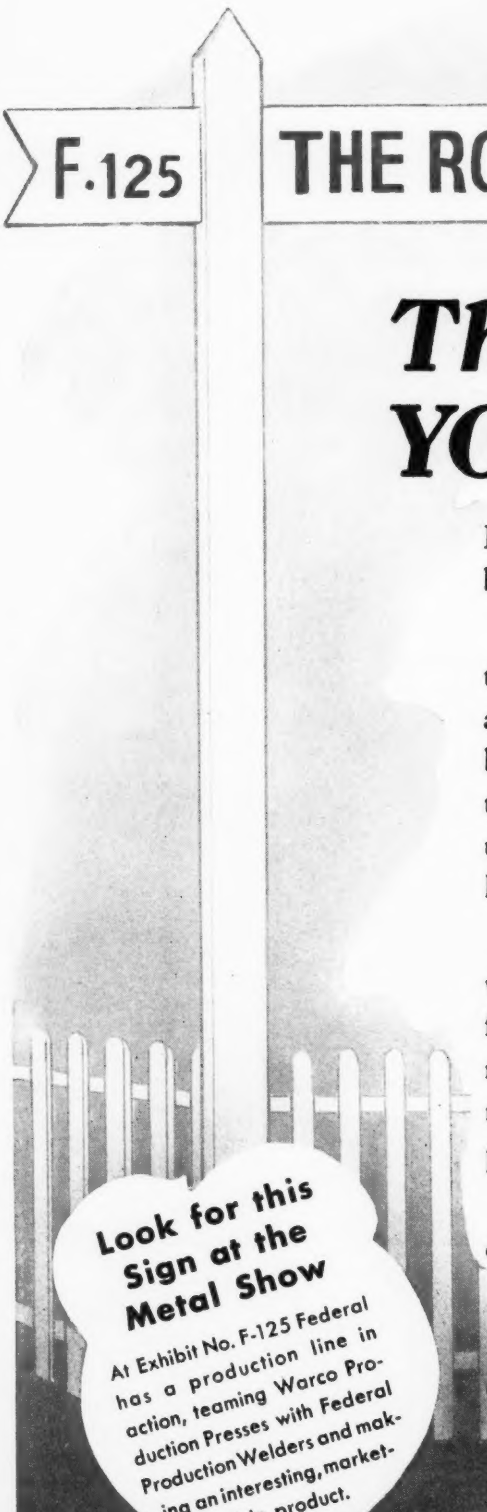
There's a Warco press for every type of production requirement. We are in position to give prompt delivery on most standard models. Your inquiry will receive immediate attention. Consult us today.

THE WARREN CITY MANUFACTURING COMPANY

1954 Griswold Street, Warren, Ohio

A subsidiary of The Federal Machine & Welder Company • Offices in Principal Cities

ECCENTRIC GEAR PRESSES • OBI PRESSES • HYDRAULIC PRESSES • MECHANICAL PRESS BRAKES
HORN PRESSES • DOUBLE CRANK PRESSES



This is the Road YOU Live by . . . .

History's hungriest market for manufactured goods is lined up beside the world's greatest facilities . . . still waiting.

It seems like simple common sense, then, to face the fact that YOU have a tremendous personal stake in seeing that more and better goods are produced through YOUR efforts than ever before. The Road to Production leads to individual security through PERMANENTLY improved living standards. It can take us far, or to a dead end, depending upon how each of us adapts himself to that first essential . . . MORE OUTPUT.

Federal specializes in upping efficiency through automatic welding, which offers more improvements in metal goods manufacture than any other single method or "tool" we know. Wherever metal fabricating or fastening on a production basis is a problem, resistance welders of one type or another usually provide a profitable solution.

Federal makes every type of resistance welder . . . many specially developed by our welding engineers for highly special needs.

Random examples of every-day production "step-ups" with Federals are illustrated at right. There's a Federal representative in every key city qualified to show you similar methods to speed YOUR goods on the Road to Production.

Production Provides Permanent Personal Prosperity

THE Federal MACHINE

SUBSIDIARIES
Sommer and Adams Co., Cleveland—SPECIAL HIGH PRECISION MACHINES
The Warren City Mfg. Co., Warren—WARCO PRESSES and PRESS BRAKES


FOUR SEAM WELDS AT ONCE . . . SIX SETS PER MINUTE
PROJECTION WELDING 11,500 AUTO DOOR HINGES PER SHIFT
SPOT WELDING DEEP FREEZER PARTS
Federal
BUTT OR MITRE WELDING ALUMINUM SASH
FLASH WELDING 300 STEEL DRUMS PER HOUR

UNIVERSAL DRILL BUSHINGS

first on the market, first in accuracy and durability

Back in 1919 the founders of the Universal Engineering Co. originated the idea of standard drill bushings. Today, 27 years later, these bushings are saving countless manufacturers thousands of dollars by reducing drill breakage and insuring more accurate drilling, reaming and tapping.

From the selection of the raw steel stock to the finishing of each superhoned bore, Universal superfinished drill bushings are precision manufactured through every step. You can order Universal drill bushings, Mikro-lok boring bars, standard collet chucks, boring chucks, Wedge-lock production vises, and other superior Universal tools direct from the main plant or from the completely equipped Universal Engineering Sales Co. warehouse nearest you: 89 Main St., Ansonia, Conn., or 5629 Sixth St., Kenosha, Wisc.

We will be glad to send literature describing Universal tools upon request

UNIVERSAL ENGINEERING CO.

FRANKENMUTH, MICHIGAN

MAXITORQ FLOATING DISC — MAXITORQ FLOATING DISC

"MAXITORQ"

AUTOMATIC OVERLOAD RELEASE CLUTCH

Single type . . . ¼ to 15 H.P. at 100 r.p.m

Guardian
AGAINST OVERLOAD

Protector
OF PRODUCT and MACHINE

High speed automatic machinery, especially of the types producing breakable or damageable products, must be equipped with the means for fast, positive power disconnect. To prevent the damage which can occur with a slow or faulty action clutch we have designed a cam-action feature and combined it with the basic principle of the Maxitorq design. This provides an Overload Release Clutch which may be manually adjusted so that disengagement is automatic and instant at any determined degree of overload. Adjustment is so sensitive and action so fast that full safety is assured at all operating speeds.

The Overload Release Clutch includes all the valuable features that are winning such wide acceptance of the Standard Maxitorq Clutch . . . patented Separator Springs that "float" the discs apart to prevent heating in neutral . . . assembly, adjustment and take-apart without the use of tools . . . compact design . . . accurately machined parts for smooth assembly and long service life under hard and continued use.

Also . . . A Standard Type for General Use

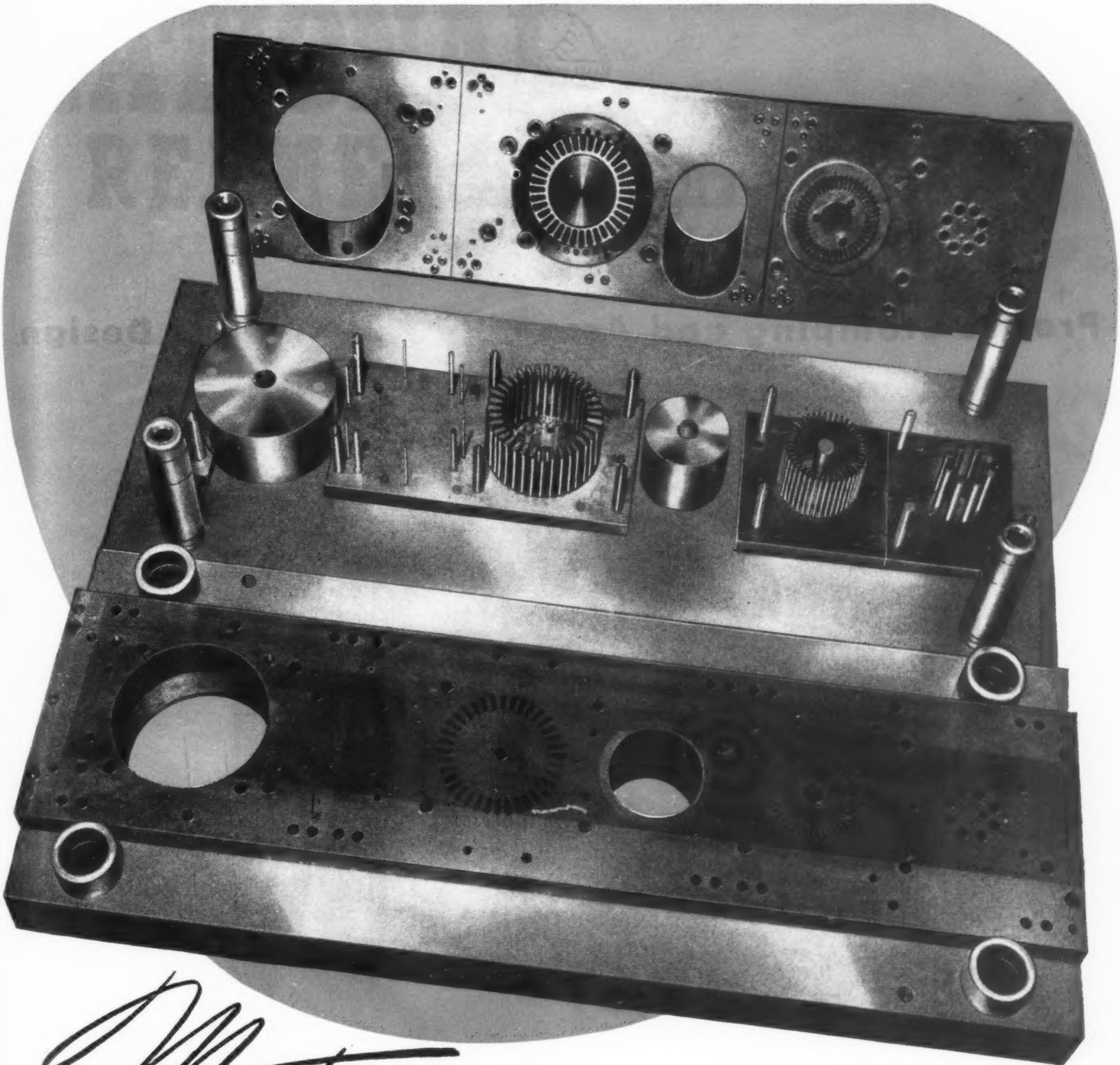
For machine tools (which do not require the overload release feature), standard and special machinery, instruments, etc., use the Standard Maxitorq Clutch in ¼ to 15 H.P. capacities at 100 r.p.m. Single and double, wet and dry types. Also for pulley and cut-off coupling installations.

STANDARD . . . DOUBLE TYPE

SEND FOR CATALOG NO. M11.

TRADE MAXITORQ MARK

THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER CONNECTICUT



Masterpiece by CROMOVAN

100,000 pieces per grind . . . 100% increase in production over former dies . . . is the outstanding performance of this Cromovan six station, progressive lamination die. The die punches out both rotor and stator laminations complete . . . from .025 silicon lamination sheets . . . clearance tolerance of .0007 inch per side is strictly maintained between punches and die. All cutting surfaces of this die are made of CROMOVAN.

Call **Firth-Sterling**

STEEL COMPANY

McKEESPORT, PA. • NEW YORK • HARTFORD • PHILADELPHIA • PITTSBURGH • CLEVELAND • DAYTON • DETROIT • CHICAGO • LOS ANGELES

NATIONAL REAMERS

The Importance of Proper Selection

In choosing reamers, such factors as the materials to be reamed, the amount of stock to be removed, and the degree of accuracy and finish required should receive primary consideration. NATIONAL Reamers include such varied types as Taper Reamers, Chucking Reamers, and Shell Reamers, to mention only a few, each designed for a specific use.

Your NATIONAL Distributor can help you select the Reamer best suited to your needs. Consult him on all your metal-cutting problems.

Call Your

DISTRIBUTOR!

Leading distributors in every section of the country have stocks of National Cutting Tools. Every National distributor offers factory-trained engineers to serve you. Call your National distributor for cutting tools or any staple industrial product.

NATIONAL

NATIONAL TWIST DRILL & TOOL ROCHESTER, MICH. U.S.A.

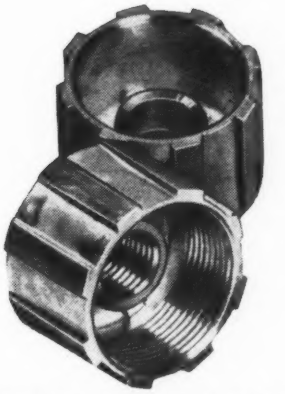
TWIST DRILLS
REAMERS, HOBS
MILLING CUTTERS
COUNTERBORES
SPECIAL TOOLS
END MILLS

TWIST DRILL AND TOOL COMPANY

ROCHESTER, MICH., U.S.A.

Tap and Die Division—Winter Bros. Co.

Factory Branches • New York • Chicago • Detroit • Cleveland • San Francisco • Distributors in Principal Cities



9 seconds

~~TAPPING TIME: 18 SECONDS~~

Die-cast aluminum pistons of popular Gabriel Aerotype Shock Absorbers have two concentric tapped holes. One, in the skirt, is 1" diam., 20 pitch, to receive the piston head. The other, 7/16" diam., also 20 pitch, receives the shaft. Tapping time, using two machines with cross-slide feed, was 9 seconds for each hole—18 seconds per piece.

Cost-wise Gabriel production executives reasoned that, if the two holes could be tapped simultaneously, tapping time would be cut in half. Ingeniously, they bored out the center of the larger tap and fitted the smaller one into it, producing a tool to do the job.

But perfect alignment, accurate sizing and correct depth were essential because the skirt of the piston is only 3/32" thick before tapping and the shaft must be precisely centered through the seal.

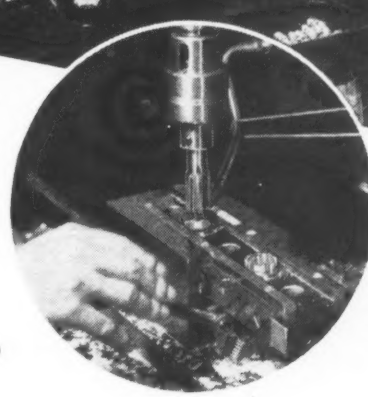
Fortunately, Cleveland Lead Screw Tapping machines meet all these requirements. The hardened and ground lead-screw feed, rigidity of the spindle and precise depth control provide the accuracy needed for the job. So today, Gabriel has a battery of four Clevelands with cross-slide feeds tapping both holes simultaneously. Tapping time per piece has been reduced to 9 seconds.

Rejects are negligible and the Cleveland's enclosed coolant system under the operator's control assures maximum tap life.

Scores of Cleveland Tapping Machine users are enjoying similar tapping economies—even on Class 3 and 4 fits on a production basis.

If your product must be drilled or tapped . . . one hole or a dozen . . . Cleveland engineers can probably show you how to speed production and cut costs. Send blueprints and specifications or sample parts to The Cleveland Tapping Machine Company, Hartville, Ohio.

TAPPING GABRIEL PISTONS



CROSS-SLIDE FEED

CLEVELAND
lead screw
tapping machines

Your copy is ready

The new, enlarged edition of the popular "Production Tapping Guide" has 24 pages of valuable data for use of the estimator, set-up man and operator.

MAIL THE COUPON FOR YOUR FREE COPY

The Cleveland Tapping Machine Co.
Hartville, Ohio

Send a copy of the Production Tapping Guide to

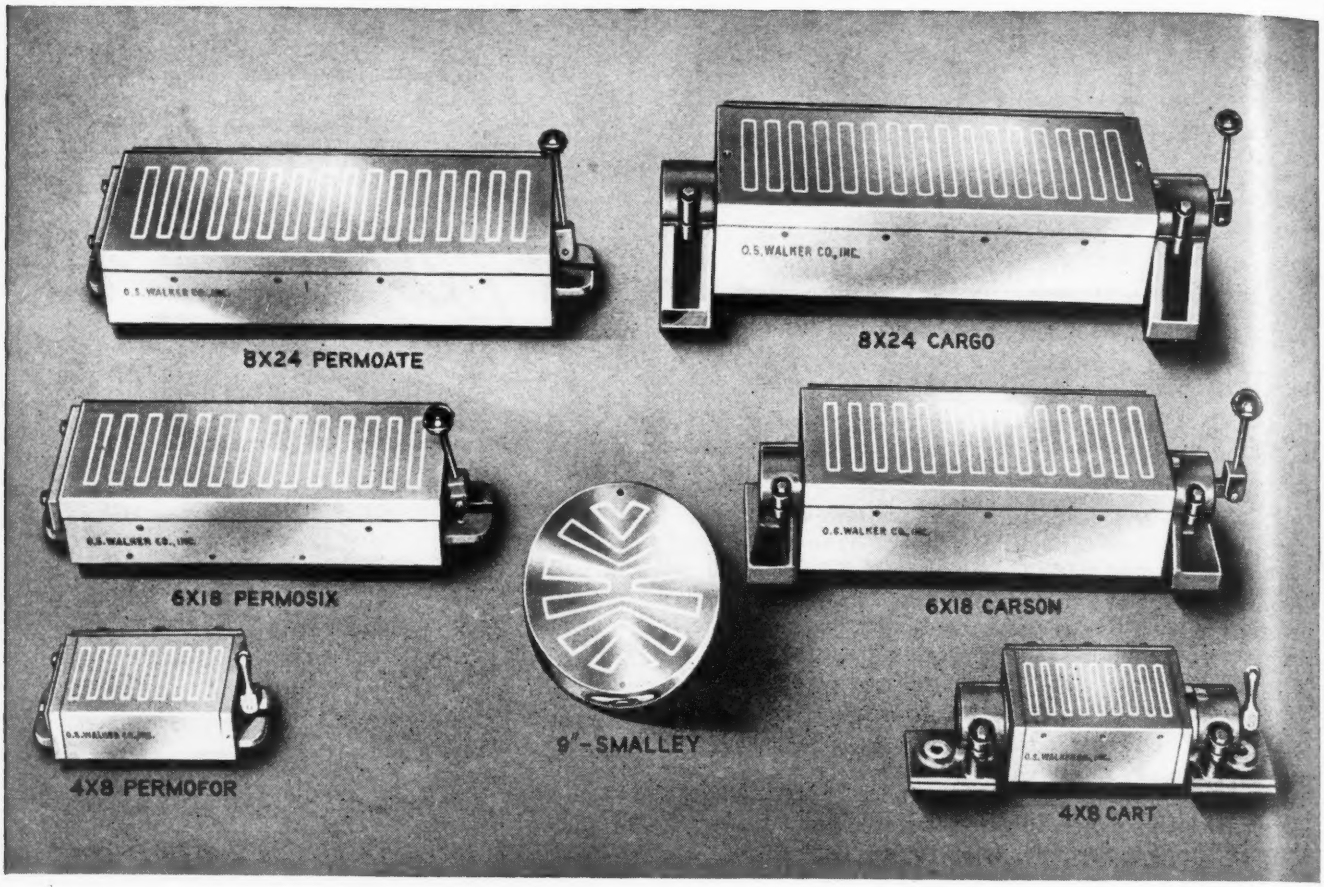
Name________________________

Position________________________

Firm________________________

Address________________________

City____________Zone______State________



MEET THE WALKER *Permanent* CHUCK FAMILY!

Truly a credit to the O. S. WALKER CO.

Over 60 years of chuck building, design, and engineering experience are incorporated into these "PERMOS."

WALKER ENGINEERS invite you to present your problems for solution at no obligation.

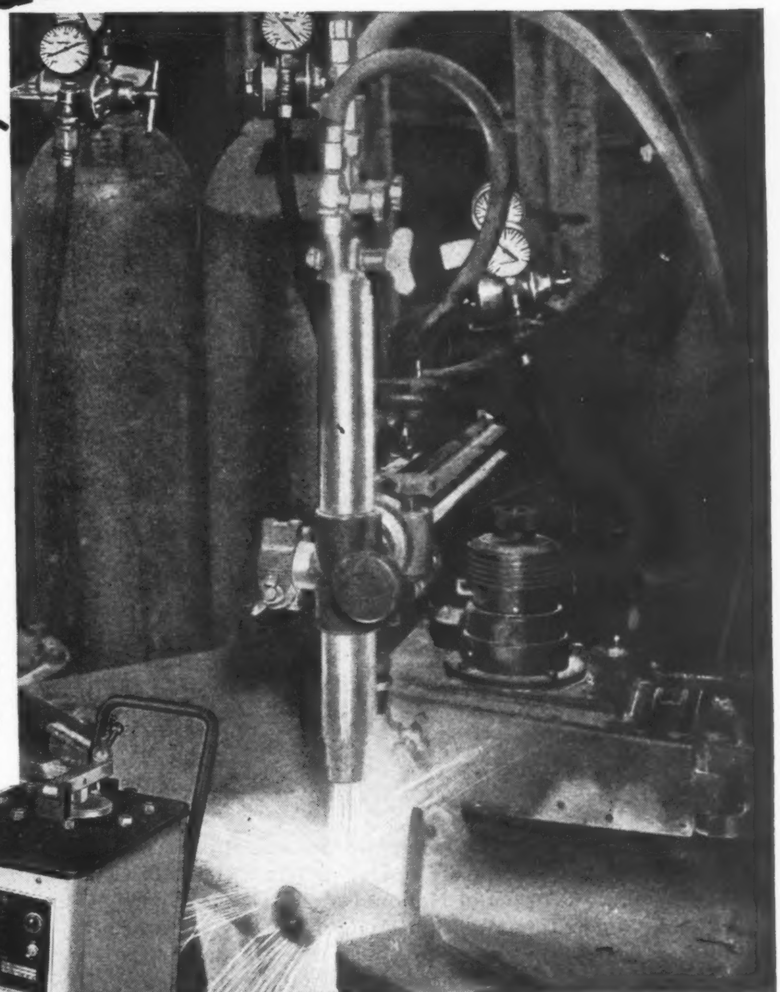
REMEMBER, there is a WALKER CHUCK for every known application.

Walker Chucks

O. S. WALKER CO., INC., WORCESTER 6, MASS.

here it is!

the answer to stainless steel cutting with the oxyacetylene flame



Airco's new Flux-Injection Method of stainless steel cutting points the way to important savings by eliminating the slow, laborious melting-away and mechanical processes now in common use. With the NEW Airco process, stainless steels containing alloying elements as high as 50% can be oxyacetylene flame cut as readily as ordinary steels.

Designed for use with standard Airco oxyacetylene equipment, this new Airco stainless steel cutting technique keynotes simplicity, safety and economy of operation. In fact, operating conditions and instructions for stainless steel cutting approximate mild steel, and "cut-speed" is comparable.

The Flux Feeder Unit is portable, even when fully charged, so rapid movement from job to job is assured. The Unit feeds the flux into the cutting oxygen stream. Thus, the flux is continuously and evenly dispersed throughout the entire cutting operation.

An explanatory article — "Flux-Injection Method Brings Economies of Oxyacetylene Flame Cutting to Stainless Steels" — will be available shortly. Fill in and mail the coupon for your copy. Air Reduction, General Offices, 60 East 42nd Street, New York 17, N. Y. In Texas: Magnolia Airco Gas Products Company, General Offices, Houston 1, Texas. Represented internationally by Airco Export Corporation.

AIRCO

AIR REDUCTION

Offices in All Principal Cities

ORIGINATORS OF MODERN OXYACETYLENE AND ELECTRIC ARC METHODS FOR METAL FABRICATION

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AIR REDUCTION
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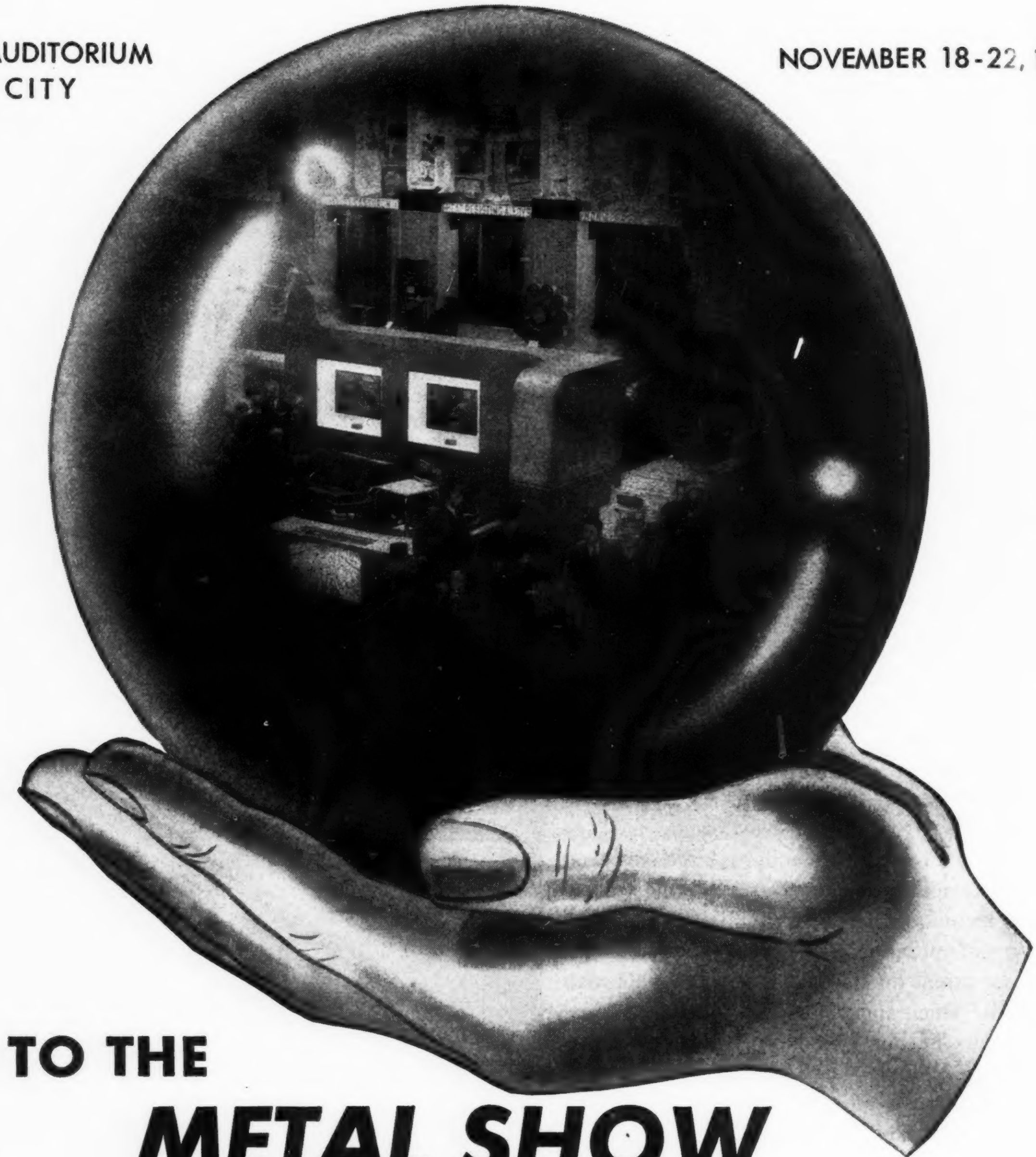
New York 17, N. Y.
(I)—1

Please send me a copy of article: "Flux-Injection Method Brings Economies of Oxyacetylene Flame Cutting to Stainless Steels"

Name____________________
Firm____________________
Address____________________
City__________ Zone____ State______

MUNICIPAL AUDITORIUM
ATLANTIC CITY

NOVEMBER 18-22, 1946



LOOK TO THE
METAL SHOW
FOR PRODUCTION IDEAS

Every metal man can be a seer and get real production ideas just as quickly and easily as looking into a crystal ball by visiting the 28th annual National Metal Congress and Exposition, Atlantic City Municipal Auditorium, Nov. 18 to 22. This big event concentrates the latest ideas of more than 300 manufacturers in operating displays at the Exposition . . . concentrates the research developments of industry in fast-moving technical sessions sponsored by four great national societies.

All exhibit space in the vast Auditorium and Exhibit Hall will show advances in ferrous and nonferrous metals, in equipment and processes for heat treating, welding, cutting, brazing, machining, cleaning, plating, die casting — and a hundred-and-one other products — many shown in actual operation.

More than 100 research papers on many metal topics will be presented by outstanding metal industry experts during sessions of the Metal Congress. You will find production ideas at all of these meetings and in conversations with other metal men who will attend this annual event.

Show time is close at hand — November 18 - 22, Monday thru Friday. Make your plans to attend right away — write for hotel accommodations to the Housing Bureau, National Metal Congress and Exposition, 16 Central Pier, Atlantic City.

ATTENTION MANUFACTURERS —

A few good exhibit locations are still available. If you have a product to introduce — a metal industry market to cultivate, wire or phone for space details to W. H. Eisenman, 7301 Euclid Avenue, Cleveland — Phone Endicott 1910.

NATIONAL METAL CONGRESS AND EXPOSITION

Sponsored by the American Society for Metals in cooperation with The American Welding Society . . . The Iron and Steel and Institute of Metals Divisions of the American Institute of Mining and Metallurgical Engineers . . . American Industrial Radium and X-Ray Society.

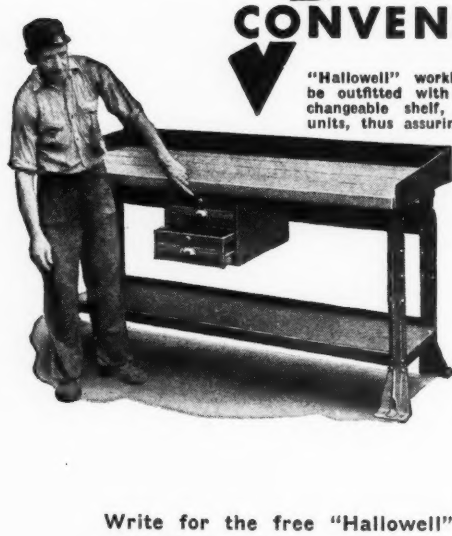
CHECK THE FEATURES YOU WANT IN A WORK-BENCH . . YOU'LL FIND THEM ALL IN

HALLOWELL

SHOP EQUIPMENT of STEEL

RIGHT SIZE

"Hallowell" workbenches of steel are available in five heights and widths and seven standard lengths. They can be moved easily and joined end to end to form a continuous work-bench. There are over 1300 combinations of "Hallowell" workbenches available.



CONVENIENCE

"Hallowell" workbenches of steel can be outfitted with a number of interchangeable shelf, drawer and cabinet units, thus assuring you of having just the right type for your particular needs. "Hallowell" benches are **READY-MADE**, too, saving you the inconvenience of construction costs, designs, and added expense. And deliveries, everything considered, are prompt.

STURDY CONSTRUCTION

Built for exceptional durability under everyday wear and abuse, "Hallowell" workbenches give you long years of service. They are built sturdily . . . will stand firm and rigid without costly bolting to the floor.

Write for the free "Hallowell" Catalog of Shop Equipment.
"Unbrako" and "Hallowell" products are sold entirely through distributors.

OVER 43 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 22
Boston, Chicago, Detroit, Indianapolis, St. Louis, San Francisco

ETNA

ALONE *gives you all these advantages*

IN A

Tube Cutoff Machine

THE TUBE REMAINS STATIONARY . . .
IT'S THE CUTTER HEAD THAT ROTATES

The entire cutoff cycle—clamping of tube, cutting off and unclamping—is completely automatic.

Single Pushbutton Controlled

•

ADVANTAGES

Operation requires no experience.

Tubes need not be straightened before cutting.

The well guarded rotating spindle is provided with a stationary liner. No revolving parts touch the tube.

Generous clamping area avoids marking or crushing thin wall tubing.

Minimum burr on tube. No tearing.

Tubing can be fed through either end of spindle.

Eliminates the fatigue experienced with operation of old type hand feed machines.

CONTROL

Convenient dial control of stepless spindle speeds within a wide range.

Push-button feed control.

Hand operated dials for easy regulation of feed rate of cutting tools. Easily adjustable rapid traverse approach of tool slides to tube and return. No cams or gears to change.

A single push-button for instant emergency stop or return of tools.

Chest high centralized panel of control dials and buttons.

Precision gauging of lengths.

Readily adjustable to various combinations of diameters, gauges and materials.

FEATURES

The spindle runs on Timken tapered roller bearings, and is V-belt driven by a Louis Allis or Reliance variable speed motor electronically controlled.

Centralized external greasing of internal parts.

Automatic feedway lubrication.

Removable hydraulic unit.

Centralized, ventilated control cabinet.

Easily installed . . . connect three wires and start operating.

Entirely self-contained compact units in capacities to handle tube from ½" O.D., ⅛" wall up to 12" O.D., 1½" wall.

THE ETNA MACHINE CO., TOLEDO 10, OHIO

Count the Cost per TAPPED HOLE

The cost of a tap is determined by its capacity to produce smooth, accurate threads with a minimum number of rejects . . . not by its initial cost. You are assured greater dependability, longer runs between grinds, speeded-up thread production by the use of Hanson-Whitney taps. Let Hanson-Whitney engineers help you lower the cost per tapped hole by applying the proper tap for a specific job. For further information, write:

Hanson Whitney Machine Company, Hartford, Conn.

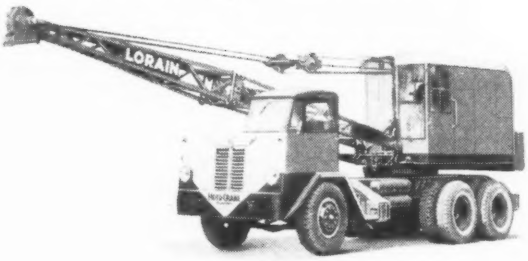
Hand it to **Hanson Whitney**

MACHINE COMPANY

HARTFORD • CONNECTICUT

How ORANGE ROLLER BUSHINGS are meeting many design problems

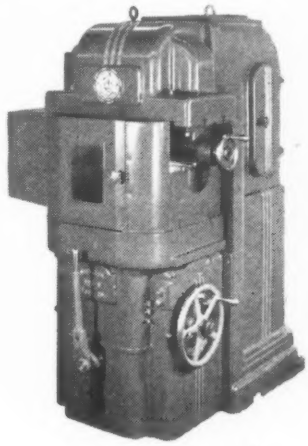
Heavy Loads—



● Thew-Lorain Moto-Cranes revolve on six Orange Roller Bushings in the front turntable. They carry the weight of cab and booms, plus lifting-loads up to 20 tons. Whether your problem is high weight load or torque load, Orange Roller Bushings will carry it—yet hold to limited space requirements.

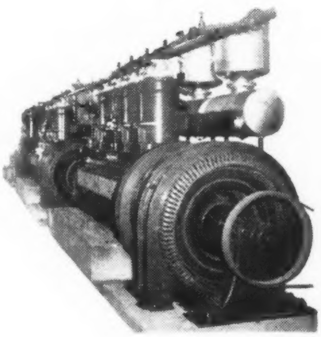
Precision Running—

● Orange Roller Bushings are used in the cross feed shaft and motor shaft of the vital Cone Drive in Michigan "806" Rotary Gear Finishers, which run so smoothly, they are almost completely noiseless. An excellent example of the even, quiet running resulting from closer internal clearances of Orange Roller Bushings.

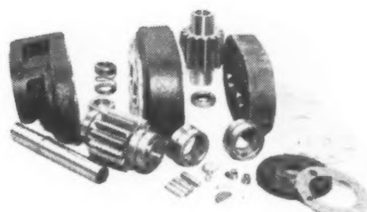


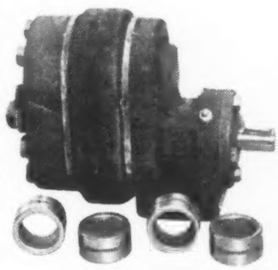
Severe Shock Loads—

● This 1150 h.p. Venn-Severin Diesel Engine carries continuous loads of 700 k.w. 24 hours a day, 6 days a week. All piston pins run on Orange Roller Bushings and are subjected to heat and repeated shock loads caused by combustion. Venn-Severin Machine Co. has used Orange Roller Bushings for a number of years with highly satisfactory results.



Compact Assemblies—





● This Gear Type Hydraulic Pump, made by Commercial Shearing and Stamping Co., shows how the smooth-running protection of Orange Roller Bushings is obtained in a compactly designed product, where space is limited and operating conditions are severe.

WHAT IS YOUR BEARING PROBLEM? *Orange Roller Bushings are available in a wide range of sizes, to meet practically all requirements. Consult with our engineers.*

ORANGE ROLLER BEARING CO., INC.
552 Main Street, Orange, N. J.

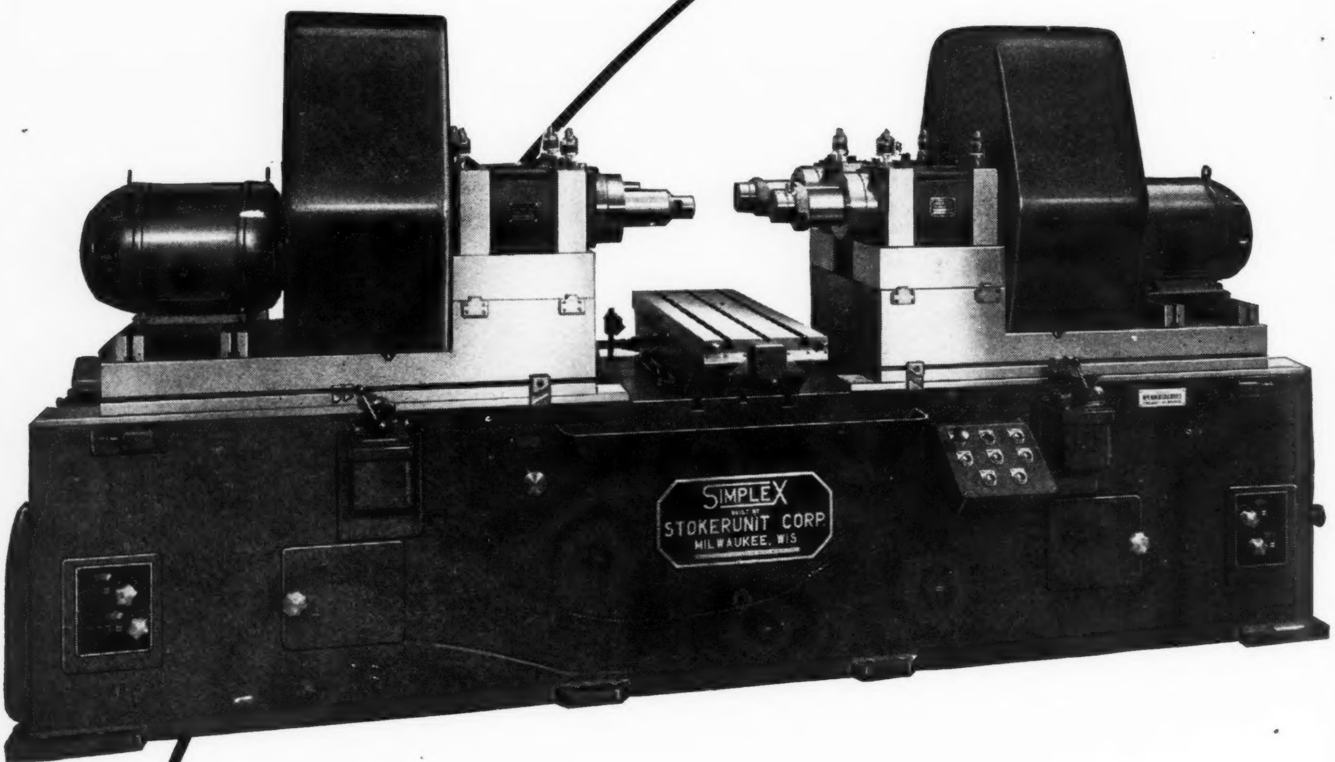
Mail Coupon for Engineering Data

Orange Roller Bearing Co., Inc., M
Orange, N. J.
Please send me your Roller Bushing Data Book

Name.................................Title..................
Company..
Address..
City.............................State...................

SIMPLEX

Increasing wage rates of today make necessary new methods of reducing costs. At medium production rates, this becomes difficult with general purpose machine tools. Simple multiple tooling and fixtures, indexing from roughing to finishing position, offer a new cost reduction method. Tooling costs are low — job possibilities endless.



This photograph shows a SIMPLEX 4U 2-way Precision Boring Machine equipped with four #4 spindles and a hydraulically indexed sliding table operating between adjustable positive stops. On the sliding base a single work holding fixture is mounted providing for operating on the work from both ends. After the roughing operation is completed on both ends, the table is indexed to the finishing position, the finishing operations are performed on both ends simultaneously and the completed job is ready to remove from the fixture to change to the next job. The fixture and tools are removed and retained intact, ready for a quick set-up when the job is again run. The automatic cycle relieves the operator and helps maintain predetermined production schedules.

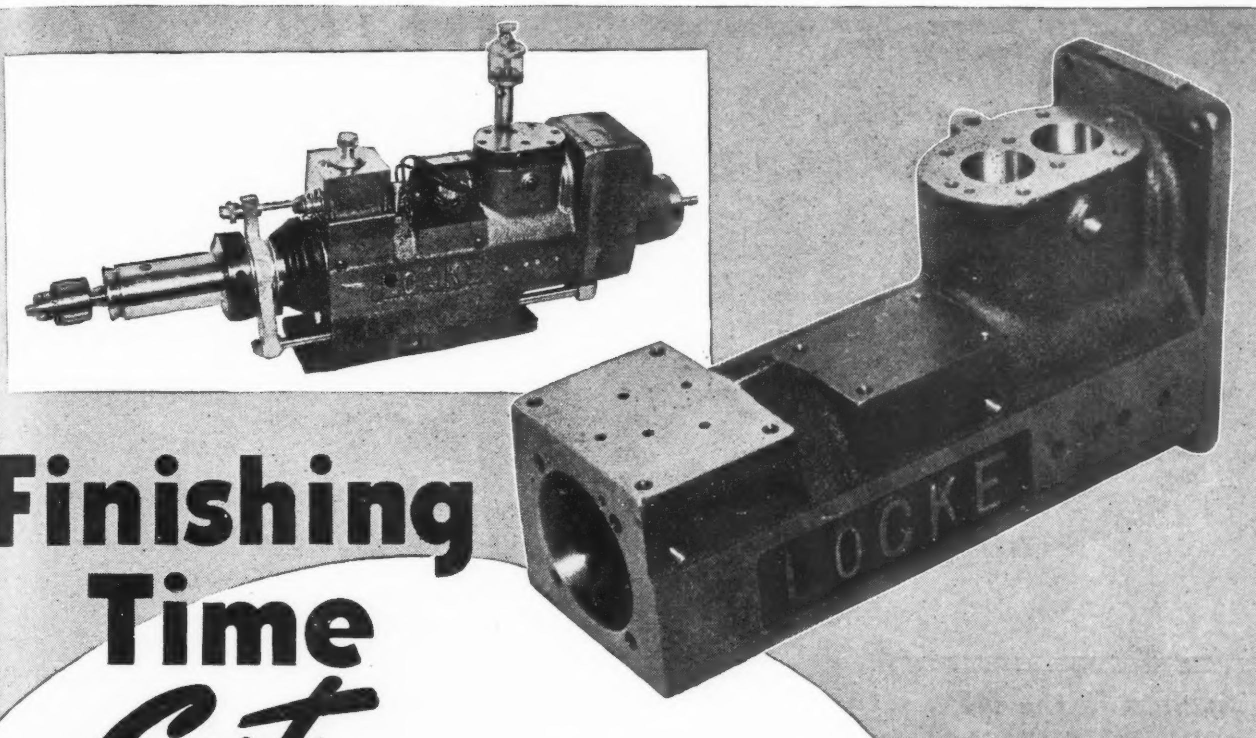
Precision Boring Machines

STOKERUNIT CORPORATION

SIMPLEX Machine Tools Division

4526 West Mitchell Street, Milwaukee 14, Wisconsin

Precision Boring Machines, Planer Type Milling Machines and Special Machine Tools



Finishing Time *Cut* from 2 hours to 10 minutes

with Sunnen Precision Honing Machine

In addition to their tremendous saving in honing time, speed of assembly of parts was increased up to 300%; breakdowns were greatly reduced because parts now wear longer. So, finishing costs have naturally dropped to about 1/10th of the former cost (exclusive of material).

This part from a pneumatic drilling and tapping unit is made of cast iron—has one large blind hole 2⅛" in diameter and two open holes 1" in diameter. Tolerances are held to within .0005" and a 15 micro-inch finish is produced.

Here are *other* advantages you get from using this machine:

Handles wide range of sizes, from .125" to 2.625" • Produces accurate holes within .0001" • Can be set up, ready to operate in 1 minute
Does not require skilled labor • Low in cost, economical to operate

Find out how these advantages can save time and money in your shop. Call in a Sunnen engineer, or write for complete details. If you have parts on which you would like recommendations, send them to the Sunnen Honing Laboratory.

SUNNEN PRODUCTS COMPANY
7940 Manchester Ave., St. Louis 17, Missouri
Canadian Factory: Chatham, Ontario

SUNNEN
TRADE MARK REG. U.S. PAT. OFF. • MARCA REGISTRADA

166

Typical Jobs

Cast Iron Valve Stem Guide. ½ to one thousandth removed—220 pieces per hour. Better finish and straighter hole.

Diesel Engine Fuel Injector Cylinder "So accurate that a piston can be fit within .00005 inch.

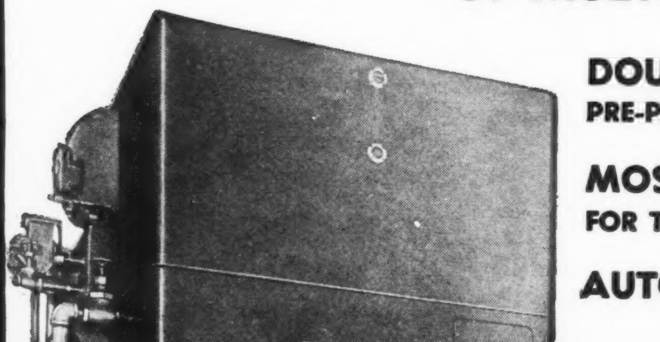
Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour.

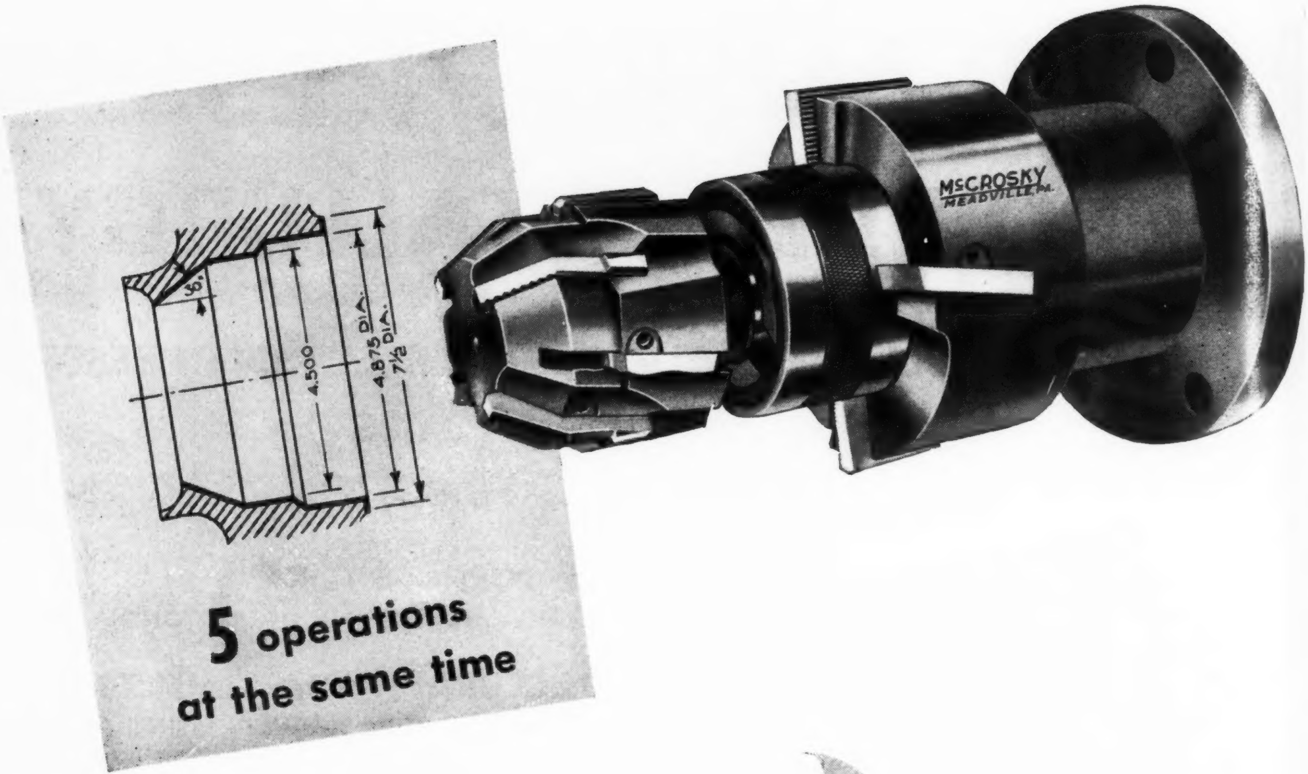
Roller Bearing Outer Race. Finish improved from 12 micro inches to 2 micro inches.

Compressor Yoke. Alignment maintained and better finish produced.

Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy.

Hydraulic Two-Way Control Valve. Hole is honed to eliminate leakage.


HYDROPRESS



McCROSKY *Multiple Operation* TOOLS... Reduce Machining Time • Speed Production • Assure Absolute Uniformity and Concentricity of the Finished Work • Save Floor Space • Cut Costs

● Combining 2, 3, 4, 5 or even more boring, counterboring, facing, chamfering, reaming and other related operations, McCrosky Multiple Operation Tools are individually and painstakingly engineered to the individual job and work conditions,—pay their way on short or continuous production runs.

Use of McCrosky's Jack-Lock wedge and other ingenious and exclusive McCrosky blade locking and blade adjusting devices, give McCrosky Multiple Operation Tools the strength and rigidity of solid tools on the job, yet permits them to be adjusted, reground, or rebladed, easily and quickly, assuring outstanding efficiency and performance.

Send for Bulletin No. S-17. It illustrates and describes more than 40 McCrosky Multiple Operation Tools,—diagrams the work they do,—and may suggest related operations in your plant too, that can be combined with a McCrosky Multiple Operation Tool, speeding up production and cutting costs.

McCROSKY TOOL CORPORATION
MEADVILLE, PA.

COST CUTTING TOOLS

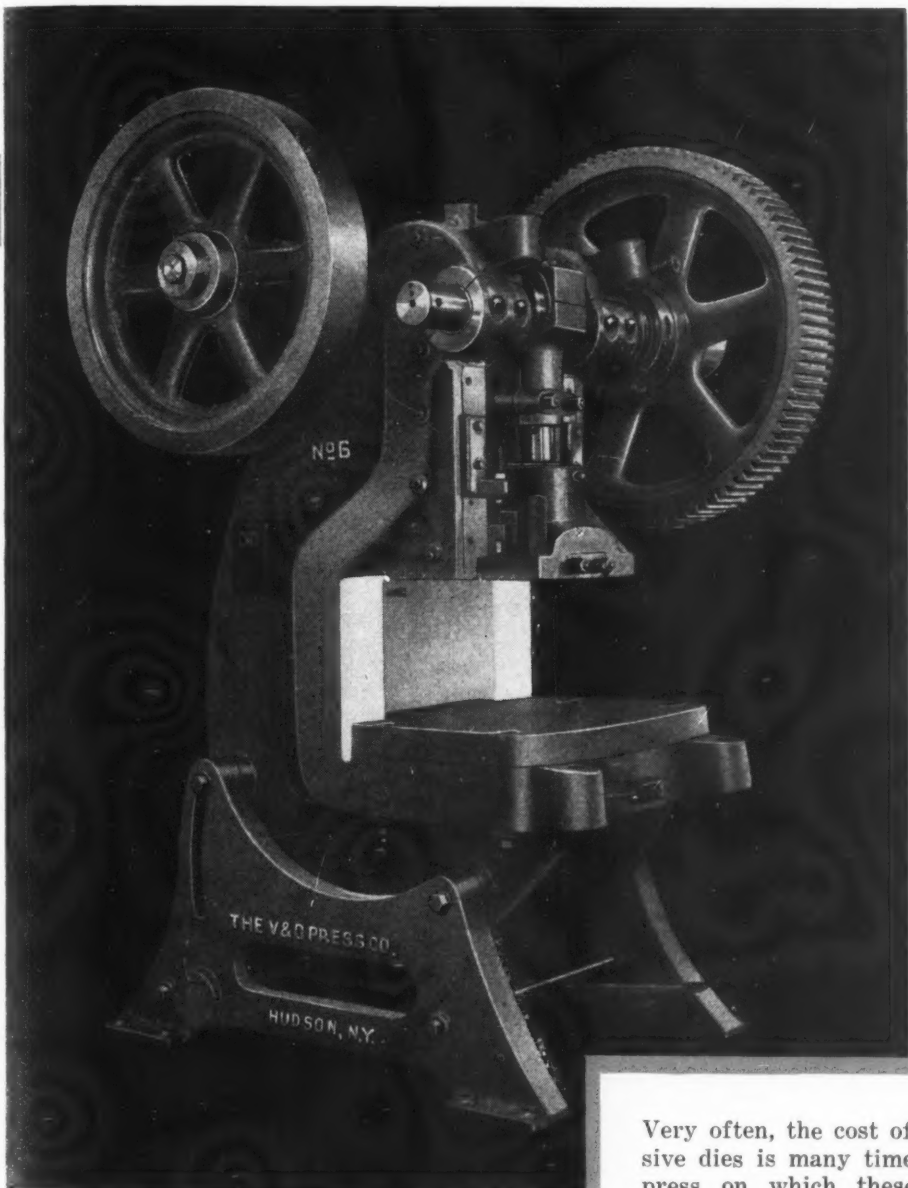
Designers and Manufacturers of

Jack-Lock **Milling Cutters** — *Super Adjustable* **Reamers**
Block Type **Boring Bars** — *Turret* **Tool Posts**
Wizard **Quick-Change Chucks** — *Special* **Multiple Operation Tools**


ELECTROLIZED


THE
LAST WORD
IN
CAP SCREWS
Positively prevents wasted time . . . each turn counts when the Knurled "Unbrako" Socket Head Cap Screw is issued. The knurled head provides a fumble-proof grip even for oily fingers, and it can be screwed-in faster and farther before a wrench is used.
"Unbrako" and "Hallowell" products are sold entirely through distributors.
Knurling of Socket Screws originated with "Unbrako" in 1934.
UNBRAKO
Reg. U. S. Pat. Off.
The "Unbrako" Socket Set Screw with the Knurled Cup-Point is a Self-Locker, because the knurled point digs-in and refuses to budge . . . regardless of the most chattering vibration! Yet, this screw can easily be backed-out with a wrench and used again and again.
Pat'd. and Pats. Pending
SIZES
No. 4 to 1⅛" diameter
You can't screw socket screws in or out without a socket hex wrench—so why not get our No. 25 or No. 50 "Hallowell" Key Kit which contains most all hex bits. The hollow handle of Celanese* plastic contains the necessary interchangeable key-bits of superior alloy steel. Bits chucked as shown, when used. Their every-day and everywhere usefulness has made them immensely popular.
*Reg. U. S. Pat.
STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA., BOX 22 BRANCHES: BOSTON · DETROIT · INDIANAPOLIS · CHICAGO · ST. LOUIS · SAN FRANCISCO

Outstanding V&O Features



Very often, the cost of modern progressive dies is many times the cost of the press on which these dies are used. Why not insure the life of your dies by using precision press equipment in your press room? We earnestly solicit that you investigate the rigidity, accuracy, and many outstanding features of the V & O Press.

THE V&O PRESS COMPANY

INCORPORATED

DIVISION OF ROCKWELL MANUFACTURING CO.

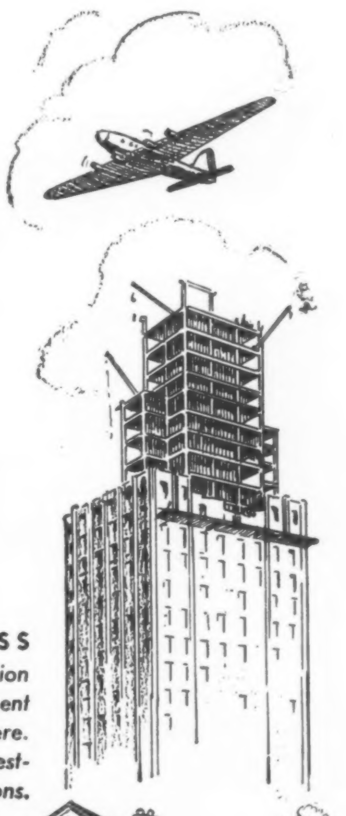
Hudson, New York

A YEAR AROUND WORKING "EXPOSITION"

If you could see at one time all of the vast variety of Yoder special metal working machinery and the production of much needed goods it makes possible daily, you would have a demonstration as great, and as important, as the National Metal Congress and Exposition, renewed at Atlantic City this month.

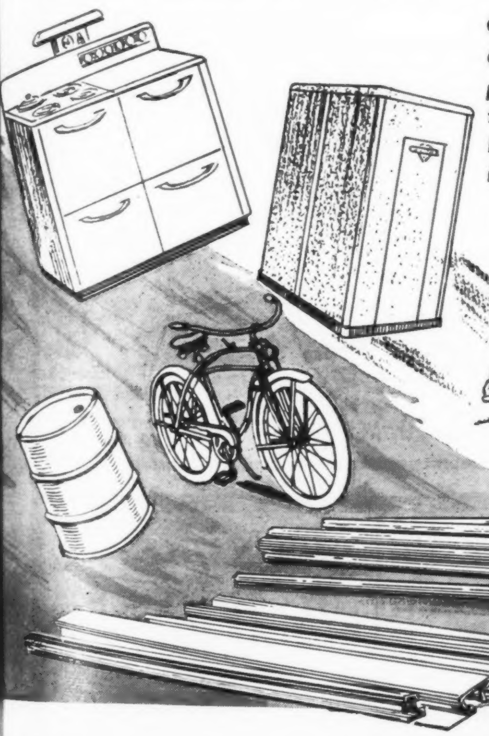
Yoder "engineered for the job" machinery has the same special purpose as the Metal Congress, namely exposition of the most efficient methods of production of metal goods. From power hammers to huge plate levelling mills . . . from coil boxes to complete plants for the production of pipe or tubing in any size up to 36" OD, the variety of applications for Yoder Machines reaches into every branch of the metal working industry.

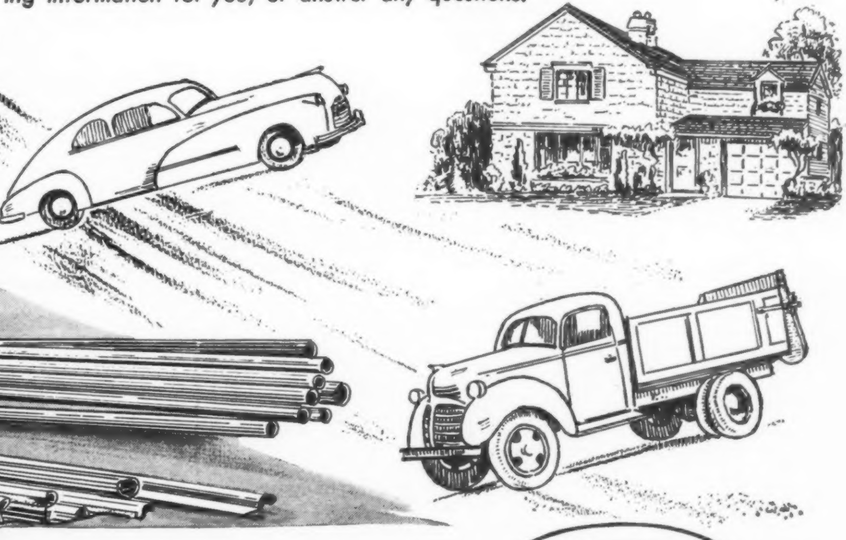
Whether you make air-conditioners or aircraft parts, doohickies or dump-trucks, you probably run into production problems for which Yoder can give you an answer, either from the regular line or something fresh off the fertile boards of the Yoder designing and engineering service.



GREETINGS, METAL CONGRESS

Complete absorption by backlogged production prevented our readying a piece of Yoder equipment for the Exposition, but Yoder men will be there. Headquarters at Hotel Dennis. We'll have interesting information for you, or answer any questions.



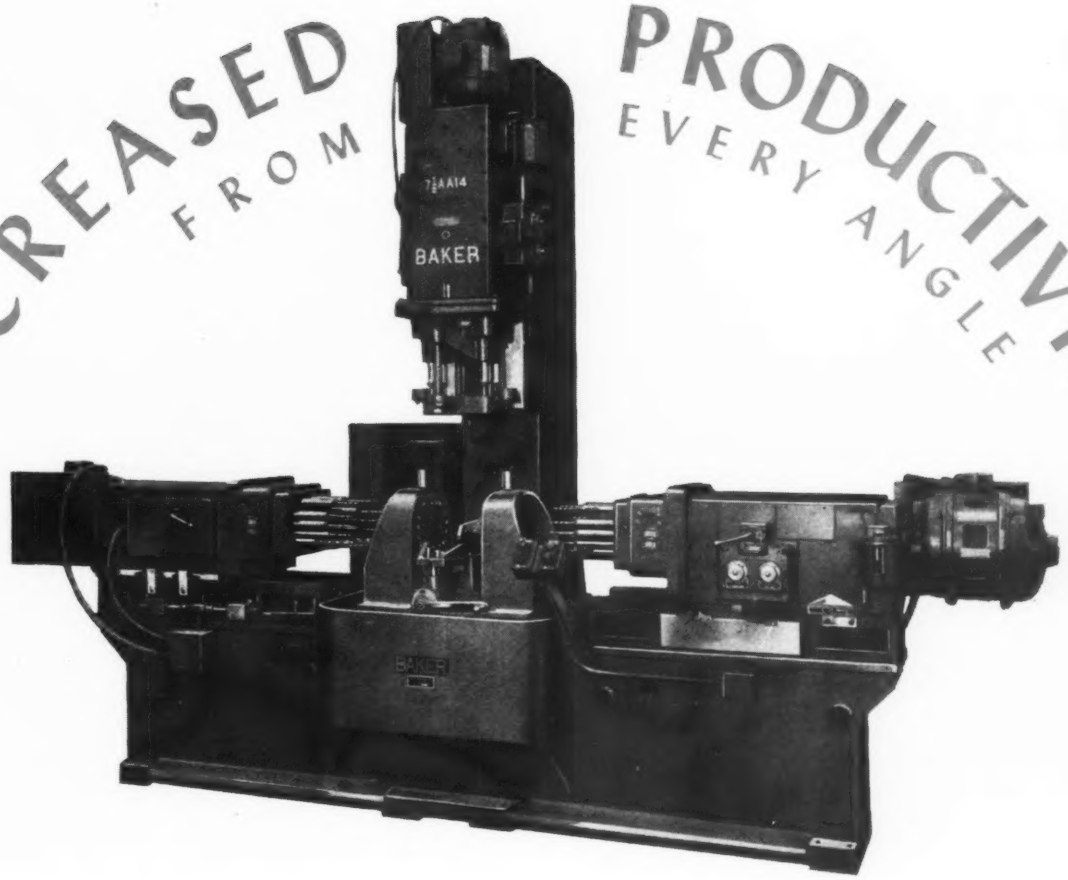


COMPANY

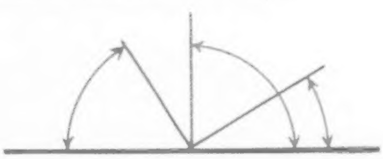
ENGINEERING
YODER
MANUFACTURING

CLEVELAND 2, OHIO

INCREASED PRODUCTIVITY FROM EVERY ANGLE

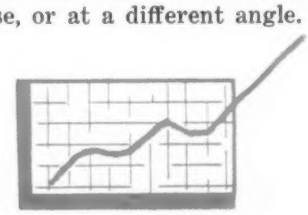


Increase productivity and lower costs by combining metal-working operations the Baker way! The Baker multiple drilling machine illustrated, for example, is designed to give all the advantages of multiple-head drilling — plus the production boosting feature of three-way operation. Holes in the two end surfaces and the top cover surface of aluminum supercharger housings are drilled in one quick, convenient, accurate operation with this simply designed machine which employs three standard Baker hydra-units.



One, two, three, or more standard Baker 7½AA-14 self-contained hydraulic units can be mounted at any angle, and in any plane, to perform single or multiple spindle drilling, tapping, boring or facing operations requiring 3, 5 or 7½ H.P. The hydraulic feed unit is powered by a variable delivery pump and equipped with a convenient control panel for setting each unit to the desired feeds. The unit can be automatically cycled with rapid traverse forward feed and rapid traverse return, and with positive stop and delayed return if desired. Flange method of mounting the multiple heads combines quick interchangeability with rigidity. Replaceable hardened steel ways assure permanent accuracy of alignment.

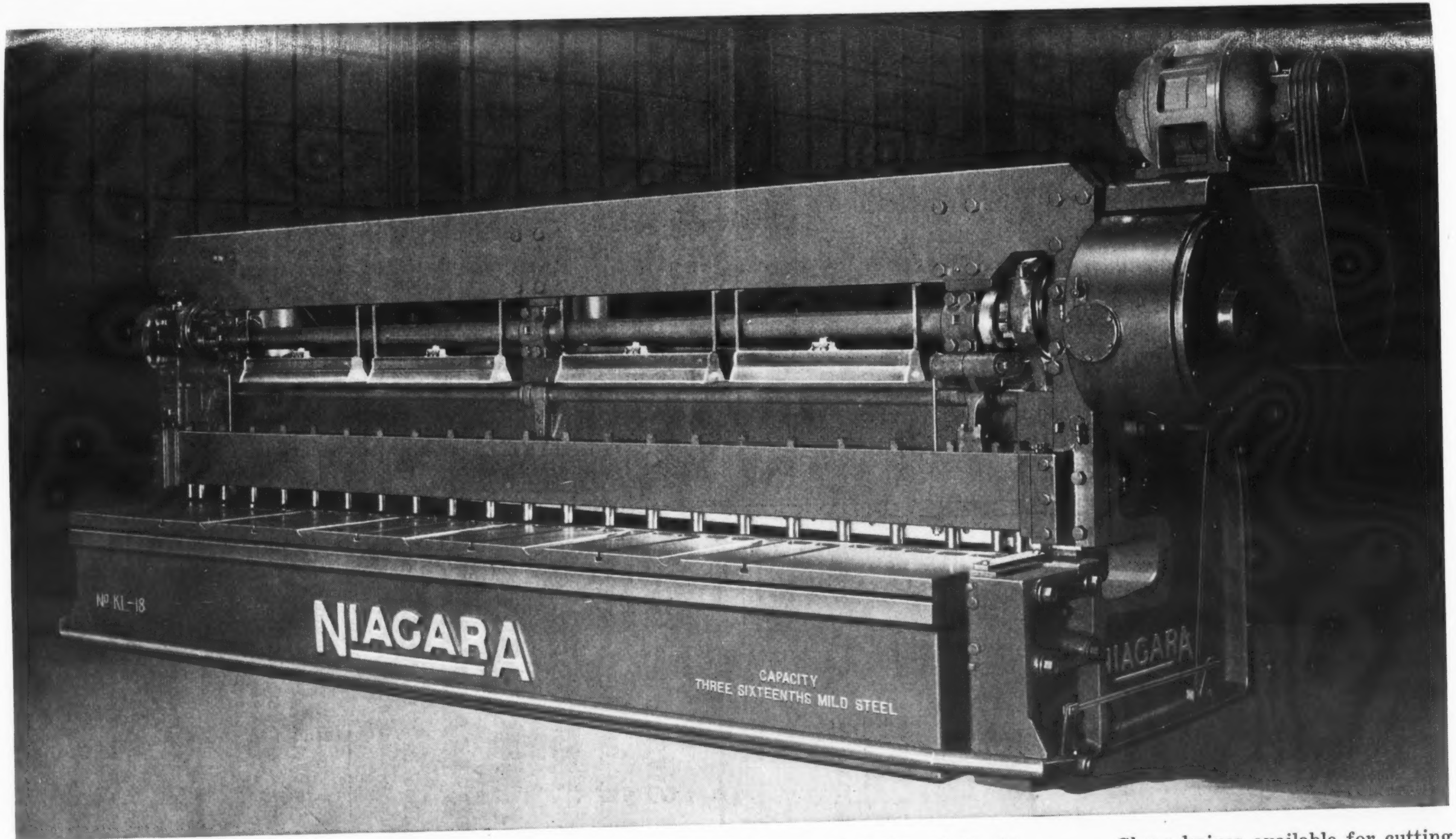
All these "special machine" advantages . . . and versatility too! Baker machines employing standard self-contained units can be changed at any time to meet engineering or product design changes. Multiple spindle heads can be replaced quickly, and the entire unit can be remounted on a different base, or at a different angle.



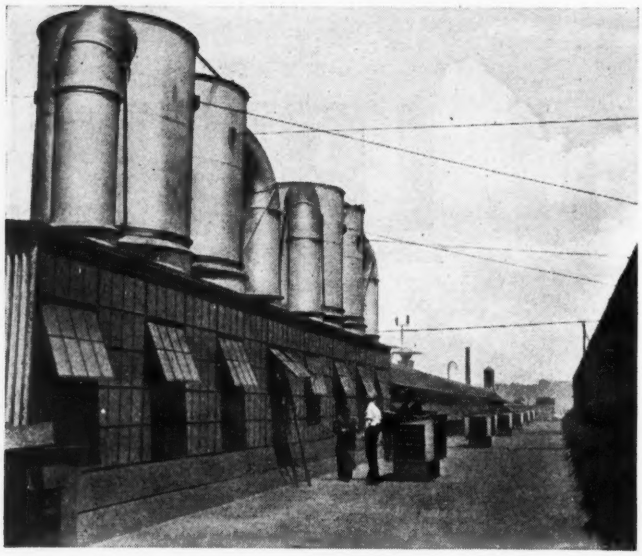
When production curves rise—cost curves go down! Write for complete engineering data and information on how Baker-designed machines can attack your metal-working problems from every angle—and give you increased productivity on scores of difficult machining jobs.

SINGLE AND MULTIPLE SPINDLE MACHINES FOR DRILLING, BORING, FACING AND TAPPING

BAKER BROS., INC. • TOLEDO 10, OHIO


NIAGARA
Nº KL-18
CAPACITY
THREE SIXTEENTHS MILD STEEL
NIAGARA

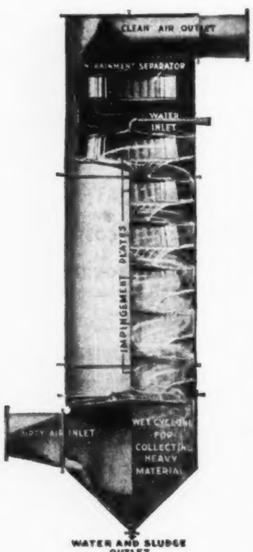
LIQUIDATE
YOUR DUST AND FUMES!



Four Schneible 20,000 c.f.m. Senior Multi-Wash Collectors at a large metal-working plant, which has since ordered two more.

WE DO mean "liquidate"—in the sense of finality, and we refer to the Schneible wet method for eliminating contaminated air.

It is definitely profitable to install the most effective equipment for dust control throughout the plant, with due consideration for operating and maintenance costs. Clean air pays dividends. Schneible Multi-Wash equipment has proved so effective for dust and fume control that it is used by manufacturers everywhere.



For disposal of the dust, nothing equals the Schneible wet method. Schneible Multi-Wash Collectors use water to wash dust and fumes from the contaminated air. The collected matter, as sludge, flows to a de-watering tank (or waste). The sludge is settled out and the cleared water is re-circulated.

In operating and maintenance costs, a Schneible system is the absolute low. No attendance required. No bags or filters to shake daily or replace. No moving parts; nothing to break, clog, burn or rapidly wear.

Practically every dust and fume condition can be effectively controlled with standard Schneible units.

Send for informative bulletins.

CLAUDE B. SCHNEIBLE CO.

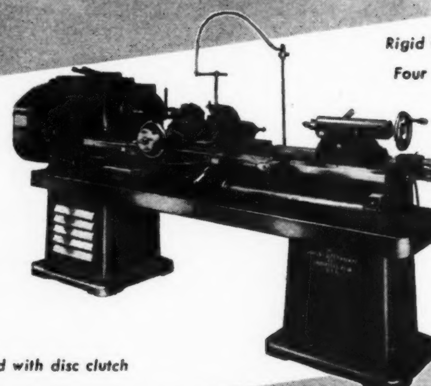
2827 Twenty-fifth St., Detroit 16, Mich.

Engineering Representatives in Principal Cities

SCHNEIBLE

---

40 YEARS of EXPERIENCE
produced
the new COULTER
AUTOMATIC THREADING LATHE

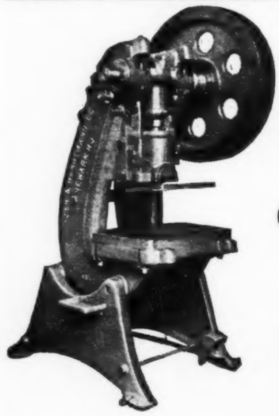


Rigid Construction
Four speed headstock
Equipped with disc clutch
Easy to operate

The many different and number of threading tools which can be arranged on the tool slides both front and rear, make this machine the most versatile of any for production of square, standard, and 29 degree threads, both internal and external.

PRODUCTION MACHINES SINCE 1896 — WRITE FOR FULL PARTICULARS

THE JAMES COULTER MACHINE CO.
BRIDGEPORT 5 — CONNECTICUT



POWER PRESSES
of all types and sizes

ZEH & HAHNEMANN CO.
182 Vanderpool Street
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JONES MACHINE TOOL WORKS, Inc.
Manufacturers of
VERTICAL SHAPERS • SLOTTERS • STRAIGHT EDGES
VERTICAL BORING MILLS
HORIZONTAL BORING MILLS
SURFACE PLATES AND SPECIAL MACHINERY
King of Prussia, vicinity of VALLEY FORGE, PA.

PERFORATED SHEETS OF EVERY DESCRIPTION

Promptly made to your specifications—any size or style perforations, any metal, any gage or size sheet. Write us.
CHICAGO PERFORATING CO.
2419 W. 24th Place — Chicago, Ill.

ACME TURRET LATHES MAINTAIN *Exceptional*

★ ACCURACY HIGH SPEED LOW COST ★

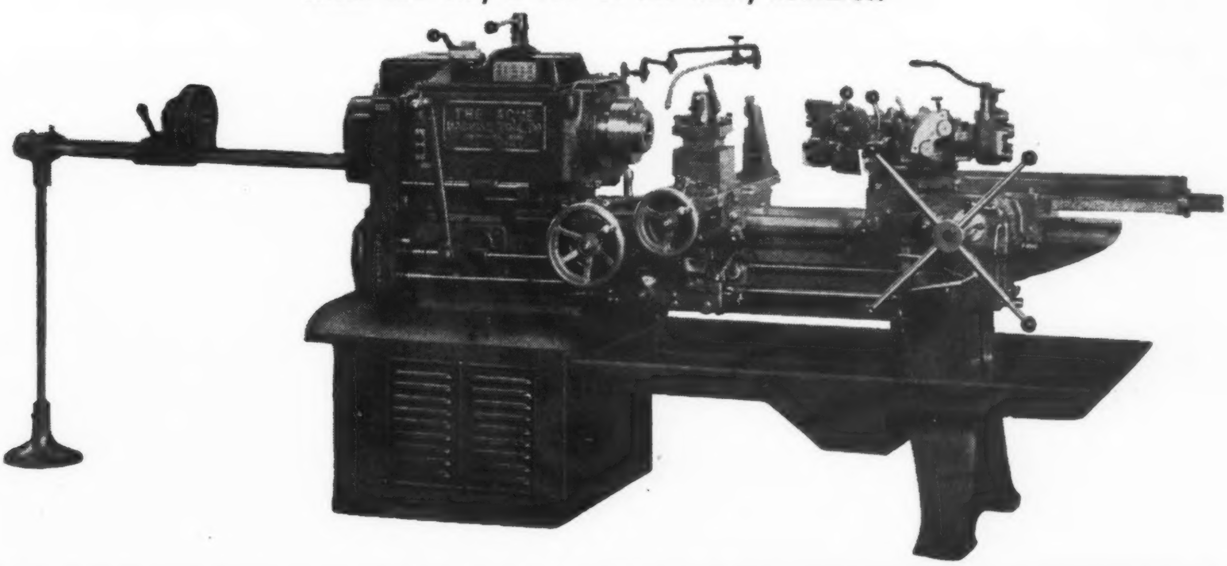
THIS Acme Ram Type Turret Lathe is fitted with Automatic Chuck and screw bar feed. It is also equipped with chasing attachment for cutting from 4 to 32 threads per inch. This attachment is extra and furnished only when required.

This type machine will accommodate round bar stock up to 2" on the No. 5R machine, and up to 2½" round stock on the No. 6R machine.

All of the most important features necessary to maintain accuracy and speed at low cost are incorporated in this design which includes:

- Hardened steel vees on bed.
- Hardened steel ram slide bearings.
- Triple roller spindle bearings.
- Twin nut back lash eliminator on cross screw.
- Non-overhanging headstock.
- Side carriage apron taper gibbed to front bearing on bed.
- Independent feed ranges for either apron.

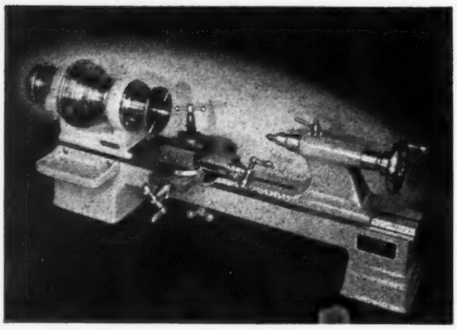
These are only a few of the many features.



The ACME MACHINE TOOL Co.
CINCINNATI 32, OHIO

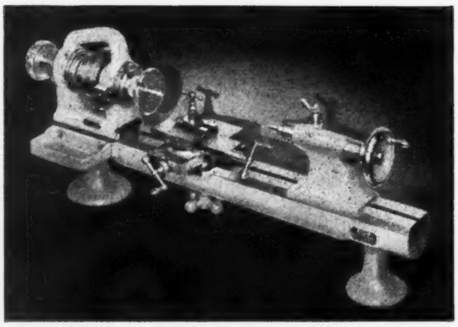
This new Bulletin MAY SAVE
YOU HUNDREDS OF DOLLARS
ON SMALL PARTS PRODUCTION
Ettco-Emrick
SYSTEM
for fast, low-cost
MULTIPLE DRILLING
AND TAPPING OF
Small Parts
WRITE TODAY FOR YOUR FREE COPY
ASK FOR BULLETIN NO. 31
Just printed, this bulletin tells the complete story of the versatile Ettco-Emrick System and Equipment that assure maximum production of drilled and tapped holes in small parts, at minimum tooling cost.
ETTCO TOOL CO., INC.
592 Johnson Avenue, Brooklyn 6, N. Y.
DETROIT • CHICAGO

SAVE TIME, CUT COSTS with these



MODEL CB-5C PRECISION BENCH LATHE

Open Cone Headstock. 1" collet capacity, 9" swing, 17" between centers, 36" bed. Speeds up to 4000 RPM. Flat belt only.



MODEL 4EV PRECISION BENCH LATHE

Open Cone V-belt Headstock. For either V or flat belt. 7/16" collet capacity, 7" swing, 17" between centers, 32" bed. Speeds to 10,000 RPM.

ELGIN

MACHINES IN UPPER ROW

(reading across)

ELGIN DESK TYPE BENCH LATHE

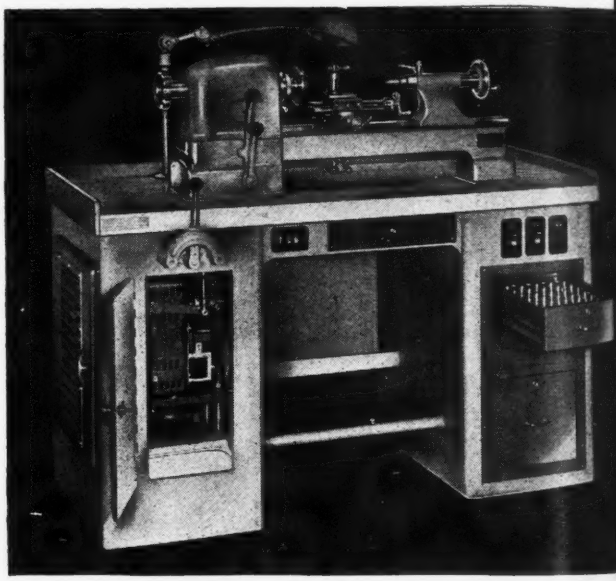
Variable Speed Drive, 40 to 4000 RPM. Low speed rate for grinding operations. Free turning spindle for truing-up and setting work by hand. Ample drawer space. 9" swing, 17" between centers, 1" collet.

ELGIN KNEE HOLE TYPE BENCH LATHE

Has Variable Speed Drive with range from 120 to 3800 RPM. 9" swing, 17" between centers, 1" collet. Generous leg room for operator. Door of motor cabinet fitted with collet rack. Three roomy storage shelves.

ELGIN OPEN BENCH LATHE

Laminated hard maple top, enclosed motor, safety guard for belt, handy collet drawer. Variable Speed Drive for any spindle speed from 120 to 3800 RPM. 9" swing, 17" between centers, 1" collet.



MACHINES IN LOWER ROW

(reading across)

ELGIN KNEE HOLE TYPE HAND SCREW MACHINE

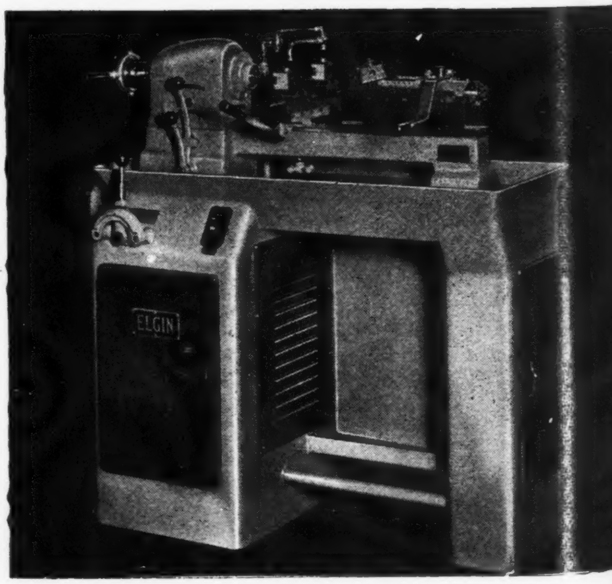
Variable Speed range, 120 to 3800 RPM. 9" swing, 1" collet capacity. Collet rack inside of motor compartment door. Independent coolant system (5 gal.) mounted in rear, outside—cleaner, more accessible.

ELGIN HORIZONTAL BENCH MILLING MACHINE

Equipped with Variable Speed Drive for spindle speeds from 85 to 2750 RPM. Collet capacity, 1". Table 4⅛" x 18". Longitudinal travel, 12". Transverse travel, 6". Vertical travel, 6".

ELGIN VERTICAL BENCH MILLING MACHINE

Preloaded ball bearing spindle. 9/16" collet capacity. Five speeds ranging from 400 to 4000 RPM. Vertical travel of spindle, 1¾". Table 4⅛" x 18". 90° swivel each side of center line.

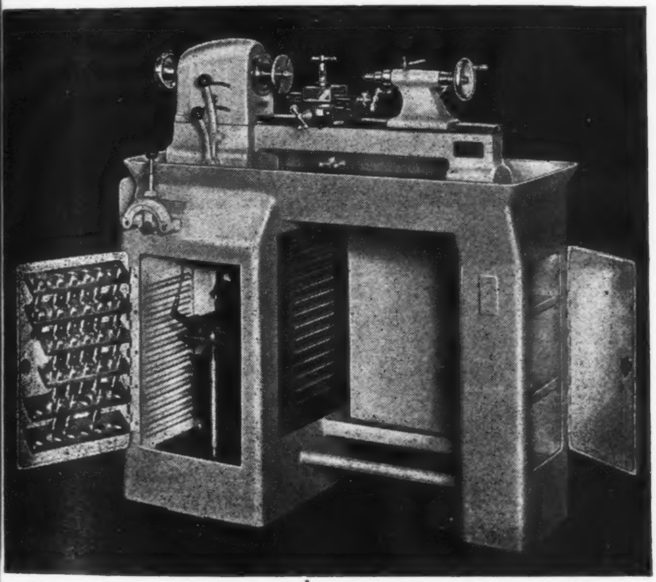


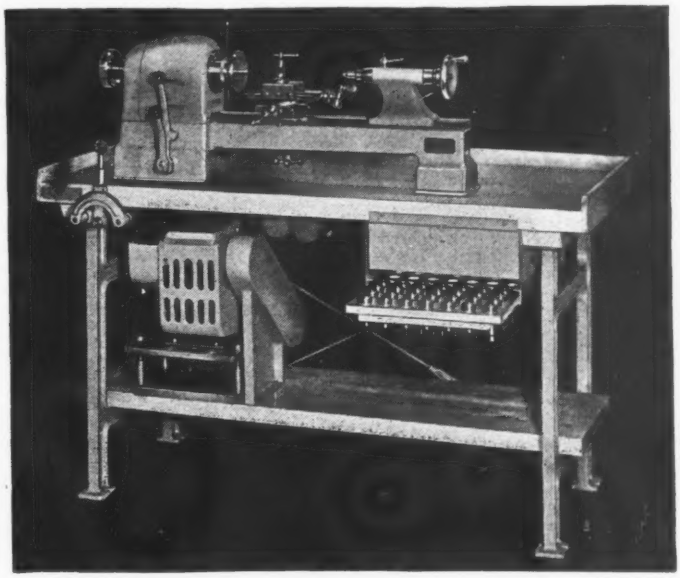
ELGIN BENCH TOOLS

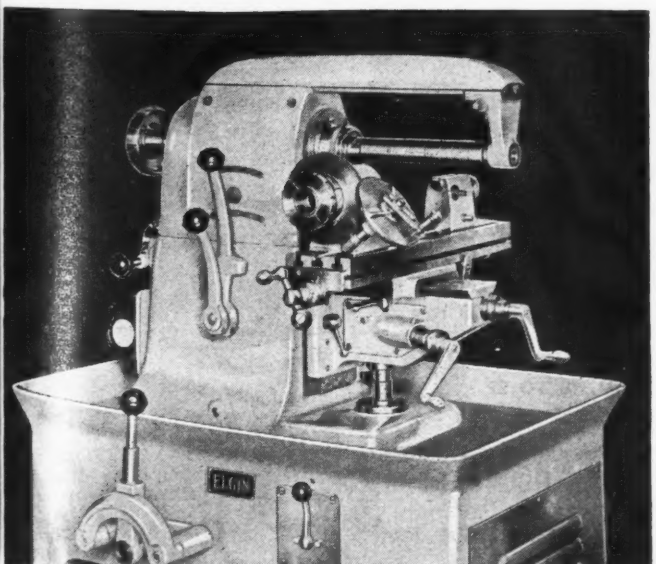
• Whatever your requirements for the fast, accurate machining of small-diameter work . . . for Tool Room or for Production . . . the ELGIN line of Precision Bench Tools assures "complete coverage" of your needs! Clean-cut in design, they are arranged to facilitate work, to give maximum operator comfort, to furnish ample storage space for tools and accessories. And most of them* are equipped with the VARIABLE SPEED DRIVE. An easy flick of the Variable Speed Lever changes spindle speed instantly to any rate within a wide range of RPM—no time out to stop machine and shift belt. Operator is encouraged to use exactly the proper speed for each successive operation, changing as often as necessary. That means closer precision, better finishes, speedier work, lower costs. Write for specifications, prices, delivery dates.

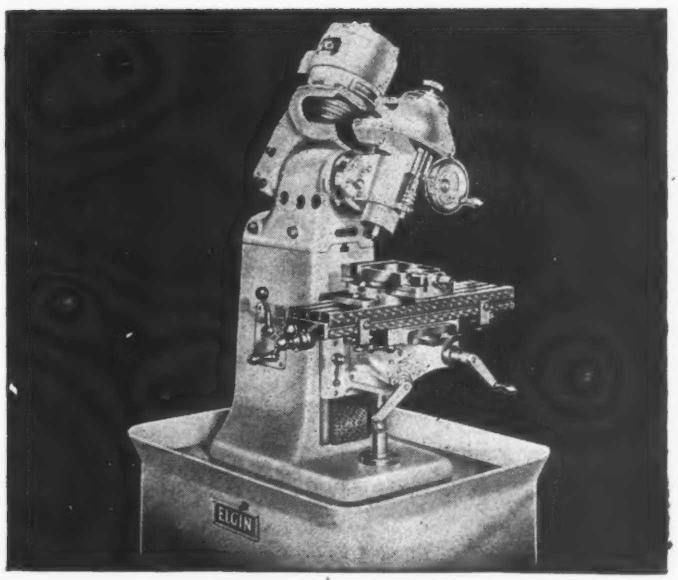
*Except Vertical Miller and the two Lathes shown in small illustrations at upper left.

TOOL WORKS 1770 BERTEAU AVENUE, CHICAGO 13, ILL.









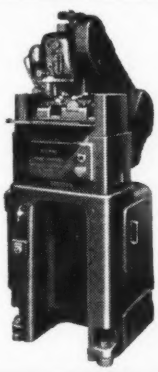
RED RING MACHINES

SHAVE GEARS UP TO 220" P. D.

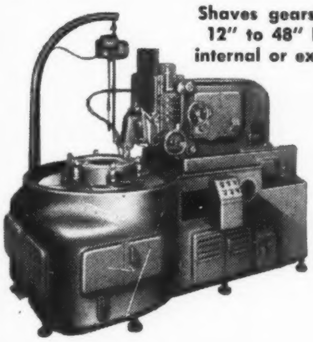
If it's a spur or helical gear of any size up to 220" P. D. there is a Red Ring Machine on which it can be shaved.

Gears up to 36" P. D. may also be shaved to the Elliptoid tooth form on Red Ring Rotary Shaving Machines.

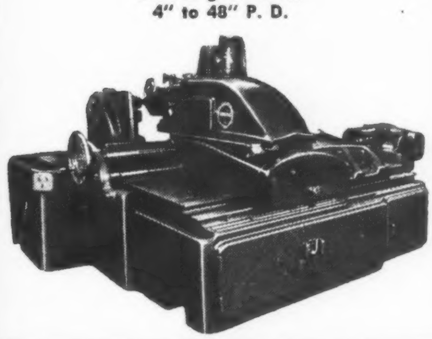
Shaves gears from 1" to 24" P. D.



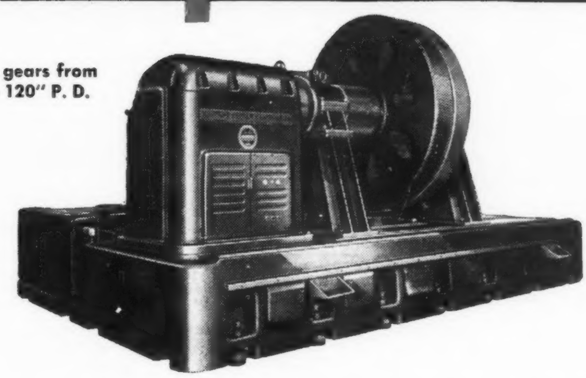
Shaves gears from 3/16" to 4" P. D.



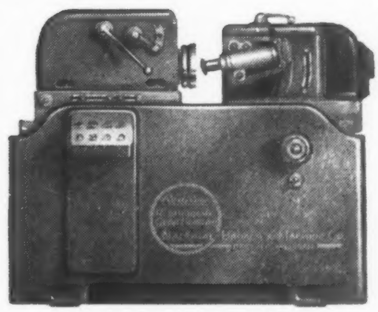
Shaves gears from 12" to 48" P. D., internal or external.



Shaves gears from 4" to 48" P. D.



Shaves gears from 24" to 120" P. D.



Shaves internal gears from 3" to 12" P. D.

NATIONAL BROACH AND MACHINE CO.

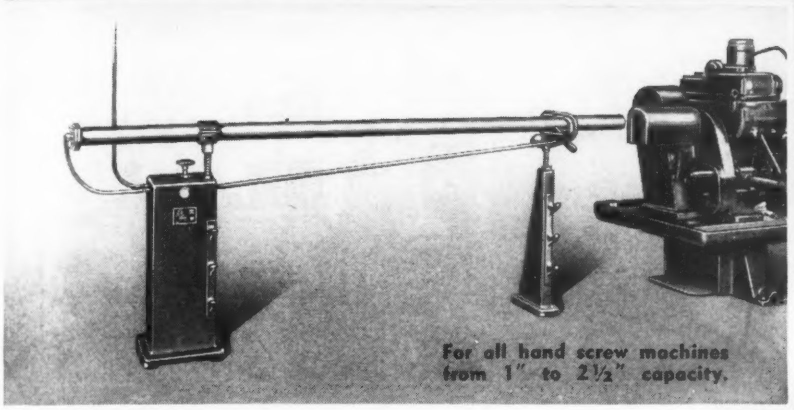
5600 ST. JEAN RED RING PRODUCTS DETROIT 13, MICH.

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

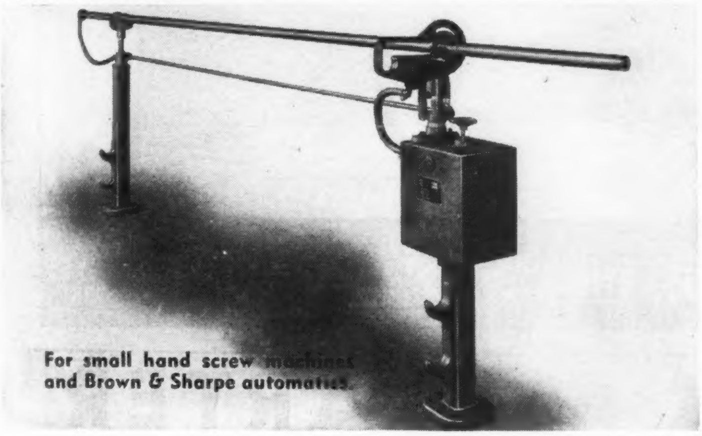
Proved in Service!

LIPE BAR-FEEDS


For all hand screw machines from 1" to 2½" capacity.

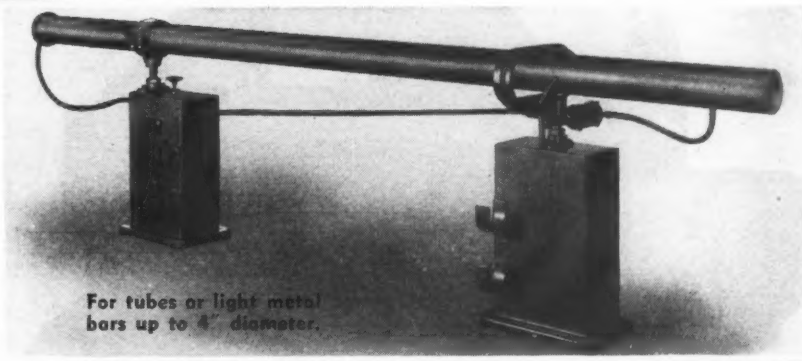
GIVE 20% GREATER SCREW MACHINE OUTPUT

in the simplest or the most complicated operations

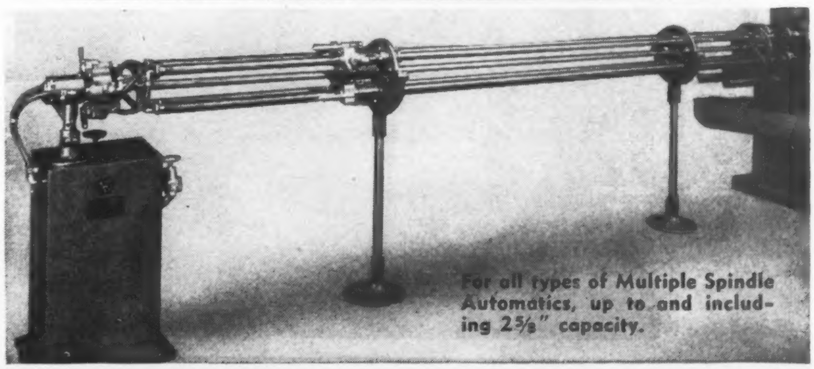

For small hand screw machines and Brown & Sharpe automatics.

DEVELOPMENT after development, built on the success of Lipe Pneumatic Bar Feeds in the hands of the most exacting production men, have provided units suitable for the smallest to the largest screw machine—hand operated or automatic. Over a wide range of screw machine or turret lathe work, all these advantages can now be made use of, in modernizing your production methods.

- Saves up to 20 minutes per 12 ft. bar.
- Feeds automatically to the smallest end piece.
- Accurately feeds any required distance.
- Handles exact-size polished stock without marring or scratching.
- No noise — safe — bar completely enclosed.
- Reduces scrap loss.
- Quickly reloaded with a single motion.


For tubes or light metal bars up to 4" diameter.

Throw away your feed fingers . . . and pushers. **See how you can get rid of complications . . . and save money. Write today for complete descriptions and engineering data.**


For all types of Multiple Spindle Automatics, up to and including 2⅝" capacity.

Lipe—**ROLLWAY CORPORATION, Syracuse 1, N. Y., U.S.A.**
Cable Address: LIPEGEAR

MOREY *Universal* TURRET LATHES
for BAR or CHUCKING

THE TURRET LATHE *Your Operator* APPROVES!

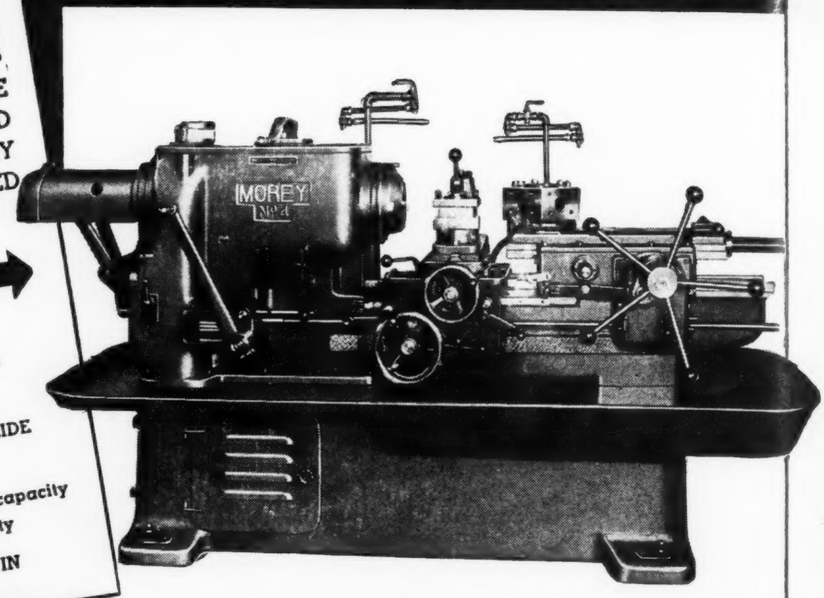
EASY TO OPERATE • ACCURATE DEPENDABLE • RIGID AND POWERFUL ENOUGH TO FULLY UTILIZE PRESENT-DAY HIGHSPEED CARBIDE TOOLS

 # 4 UNIVERSAL

For bar stock up to 2" in diameter
12" turning length 19½" swing over bed
Infinite spindle speeds: 35 to 1500 RPM.
constant speed motor, 1200 RPM
MAY BE HAD WITH PLAIN CROSS SLIDE

Also available in
No. 3 Universal, 1½" capacity
No. 2 Plain, 1" capacity

ASK FOR DESCRIPTIVE BULLETIN



STOCK DELIVERY

DESIGNED AND BUILT BY
MOREY MACHINERY CO., INC
410 BROOME STREET, NEW YORK 13, N. Y.
PLANT: 4-57 26TH AVE., ASTORIA 2, NEW YORK

ARTER
Model D 12" and 16" Rotary Surface Grinders

Improvements and refinements that insure work being ground to extreme precision and high finish . . . . ARTER MODEL D . . . . now in production.

Wheel slide hydraulically operated with piston rod and wheel spindle axis level with the longer, front extended, widened ways, gives smoothness to the traverse and stability to the spindle.

Chuck spindle mounted top and bottom in double-row, precision, preloaded ball bearings, driven by V belts from electric motor vari-speed drive unit.

Balanced motor mounted directly on the slide delivers full power to wheel spindle.

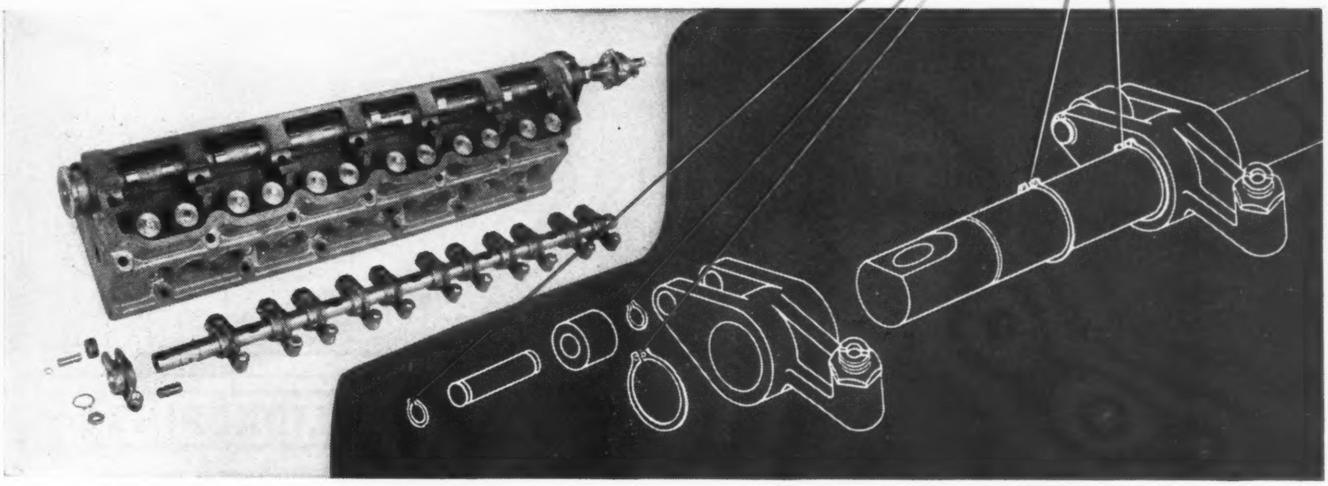
ARTER engineers are prepared to analyze your product and indicate to you how this versatile grinder can meet the most exacting requirements of your surface grinding.

ARTER GRINDING MACHINE COMPANY
WORCESTER, MASSACHUSETTS • U. S. A.

Twin Coach uses Truarc Rings on new bus engine—reduces weight ratio to 1 hp. per 4.7 lbs.

48 WALDES TRUARC RETAINING RINGS ON NEW ROCKER ARM

- **Slash Labor Costs**
- **Cut Production Time**
- **Guarantee Accuracy**
- **Simplify Maintenance**



"WE'VE FOUND TRUARC A NATURAL FOR AUTOMOTIVE APPLICATIONS!" reports Twin Coach Company, of Kent, Ohio. Their new Fageol Twin Coach engine uses a total of 52 Waldes Truarc Retaining Rings—48 on rocker arm, 4 on water pump and oil pump drive—to develop the remarkable efficiency of 1 hp. per 4.7 lbs. (the average pre-war gasoline bus engine produced 1 hp. for each 9 lbs., diesel engine 1 hp. for each 10 lbs.)

In the above applications, Twin Coach has only realized the beginning of Truarc's possibilities in the automotive field. Because of its never-failing grip, its patented design assuring constant circularity, Truarc offers great advantages to designers, production and maintenance men. Truarc is a new approach, a superior solution to fastening problems. Send us your drawings; Waldes Truarc engineers will be glad to show how Truarc can help you.

Visit Truarc Booth • Power Show • Grand Central Palace, New York • December 2-7

WALDES

TRUARC

TRADE MARK U. S. PAT. RE. 18,144

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

Waldes Kohinoor, Inc., 47-10 Austel Place 23-11
Long Island City 1, N. Y.
Please send Catalog No. 4 on Truarc Retaining Rings to:

Name__________

Title__________

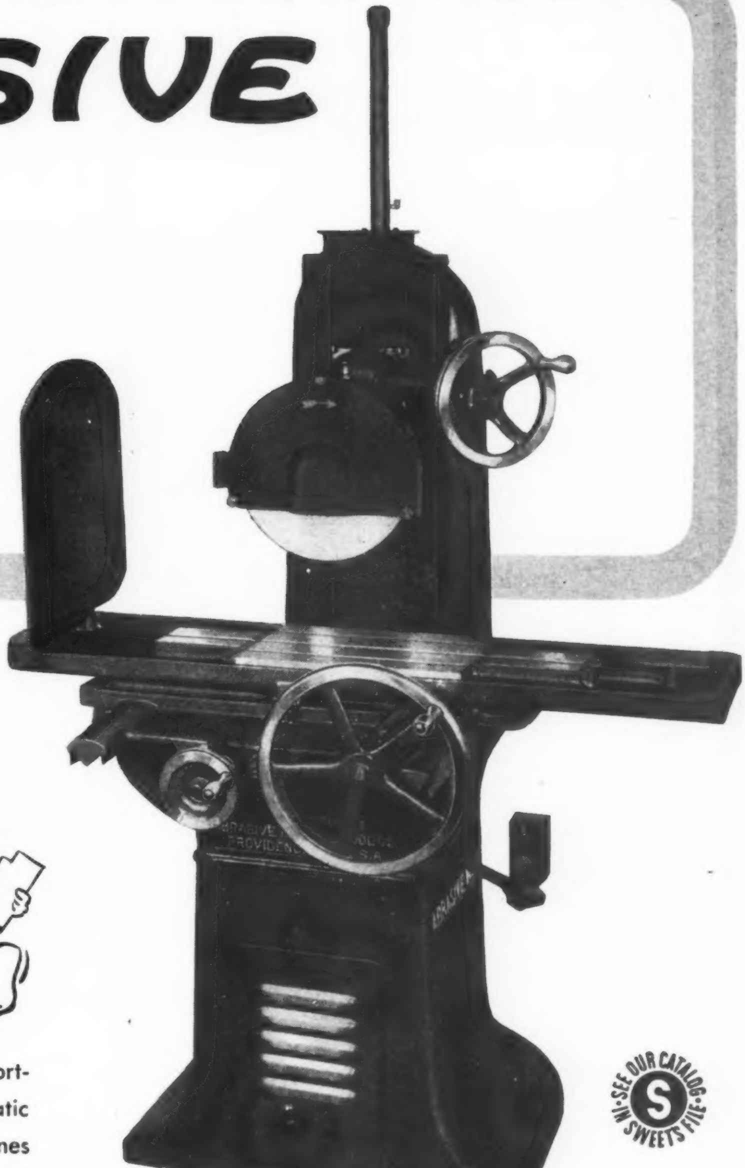
Company__________

Address__________

City__________ Zone______ State______

ABRASIVE

No. 1½ HAND FEED SURFACE GRINDER



The ABRASIVE No. 1½ completes the average short-run job before it could even be set up on an automatic machine — and it frees the more expensive machines for production runs. Unsurpassed for grinding dies, flat work and gauges, the No. 1½ grinds jobs up to 10" wide with high accuracy and an excellent finish. Its handwheels are large and conveniently located to make operation easy. There are no sprockets, chains or belting . . . the wheel head with integral motor minimizes vibration and distributes weight evenly on both sides of the guide ways. In every respect this hand feed surface grinder maintains ABRASIVE's high standards of engineering and performance.

WRITE FOR ILLUSTRATED BULLETIN

SEE OUR CATALOG IN SWEETS FILE

SPECIFICATIONS

WORK CAPACITY—15" long, 10" wide, 12" high

GRINDING WHEEL—Standard 12" diameter

DRIVE—1 H.P. motor mounted on spindle

TABLE SIZE OVERALL—48" x 11¼"

FEEDS—All hand feeds; Transverse graduated .001"; Vertical .00025". Metric graduations if specified

NET WEIGHT—1350 lbs.

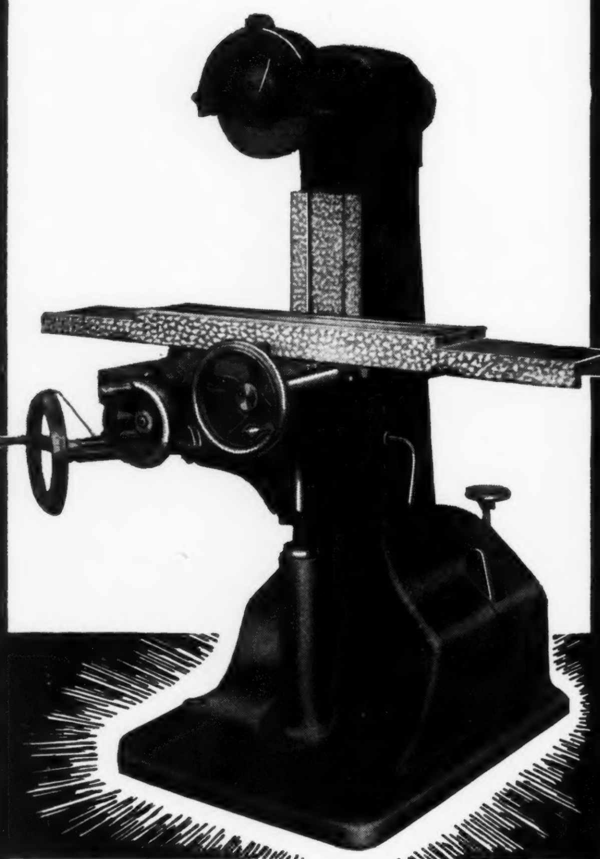
ABRASIVE

ACCURACY BOOSTS PRODUCTION

If you desire information on any Abrasive machine on the Government Surplus Tool List just send us the serial number of the machine: we will endeavor to supply attachments or repair parts as ordered.

ABRASIVE MACHINE TOOL CO.
EAST PROVIDENCE 14, RHODE ISLAND

NO. 11 LEACH SURFACE GRINDER



EXTRA LARGE CAPACITY
6" x 24" x 12"
HEIGHT 52"
WEIGHT 850 lbs.
2 SPINDLE SPEEDS
2600 and 3500 R. P. M.

$591.00

Complete with motor of standard Current characteristics F. O. B. Factory.

For further information write Dept. A

NATIONAL DISTRIBUTORS
H. LEACH MACHINERY CO.
387 CHARLES ST PROVIDENCE 4 R I
AGENTS IN ALL PRINCIPAL CITIES

CYLINDRICAL FINISHING

POLISHING

BUFFING –

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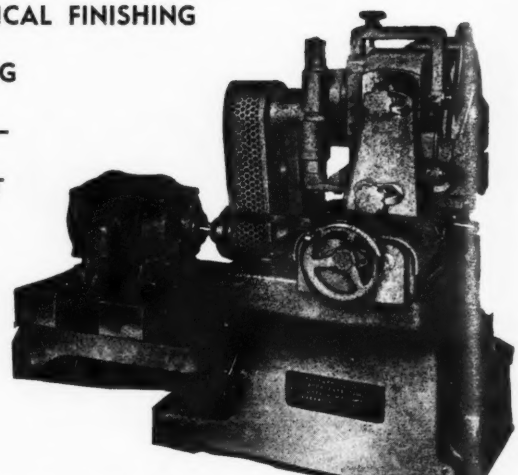


"*Production*" **FOR PRODUCTION!**

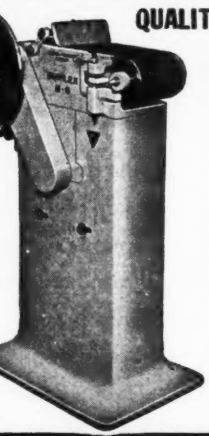
With its variable centerless feed, the "PRODUCTION" No. 101 POLISHING MACHINE enables even unskilled workers to turn out plenty of finely finished round tubes, rods or bars 1/4" to 6" in diameter. No centering, no chucking, no holding—just feed automatically. The feed can be varied (forward, reverse or neutral) and two or more machines can be set up in line for multiple operations. Write for full details of this rugged, precision PRODUCER!

Production
MACHINE COMPANY GREENFIELD, MASS. U.S.A.

QUALITY • SERVICE • DEPENDABILITY

DUPLEX M-6

HIGH SPEED BAND AND DISC GRINDER



Famous for Efficiency

The latest in pedestal type grinders. Actually two machines in one! 14" disc for all rough work . . . 6 x 48' band for finishing. Precision-built to post war standards.

Other styles and sizes in New Booklet on Finishing. Write Today.

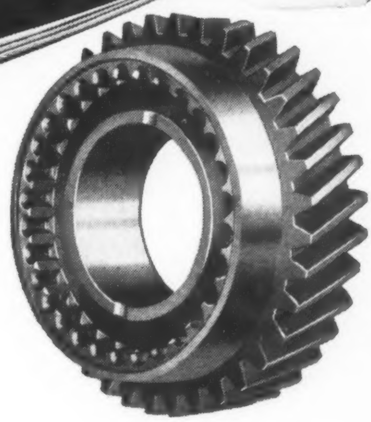
WALLS SALES CORP.
306 E. 38th St., New York 16, N.Y.

We furnish
COMPLETE HAMMERS
HANDLES ONLY
HINGED MOULDS

S&H SOFT HAMMERS

Protect jigs, fixtures, dies, tools and machined parts. Use S&H Soft Hammers. Well-balanced, flexible, safe, . . . Recast battered heads with S&H Hinged Moulds—1, 2½ and 5 lb. sizes. Order from your machine tool supply source or direct from . . .

S. & H. Soft Hammer Products Company
15410 Stoepel Ave. DETROIT 21, MICHIGAN



Producing ten gears hourly, this form tool method of gear tooth milling eliminates one drilling and one relief turning operation.

HERE is another example of how a Cross machine, utilizing "Selected Sequence" in automatic cycle operation, met the requirements by producing more accurately, at a higher production rate, at lower cost, with an unskilled operator. Further, it made possible a change in product design which added strength to the gear it produced, and improved resistance to sudden or heavy torque loads.

The No. 52 Milling Machine is made up of standard machine parts to provide a low cost, compact unit for specialized requirements, yet readily adaptable to a wide variety of work—for profile milling, for milling numbers of equally spaced internal or external slots, or for diversified operations on gears.

In action, the special form end mill rapidly advances horizontally to a predetermined position inside the gear and then feeds upward. After milling, the cutter retracts quickly to clear the cut, and the fixture automatically indexes to the next position. The programmed sequence of the automatic cycle is interlocked for safety.

Without obligation, we will be glad to analyze your production problems, and make recommendations. Consult Cross to cut cost.

THE **CROSS** COMPANY

Established 1898

SPECIAL MACHINE TOOLS

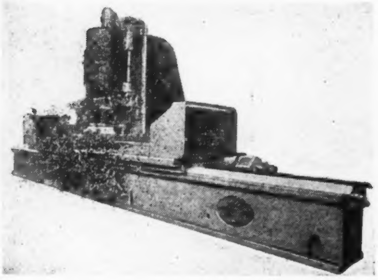
DETROIT 7, MICHIGAN

MILLING • DRILLING • TAPPING • BORING • TURNING • SHAPING • GRINDING • HONING

LOOK TO "BRIDGEPORT" FOR

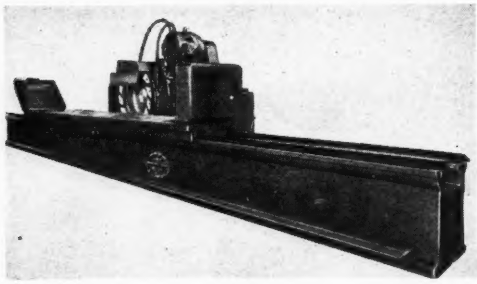
UP-TO-THE-MINUTE GRINDING EQUIPMENT

FOR EVERY AUTOMOTIVE REQUIREMENT



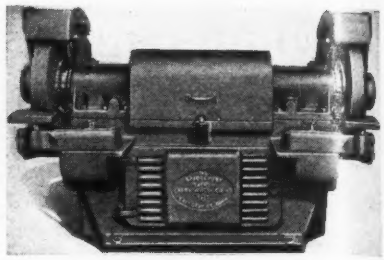
No. 103
VERTICAL SURFACE GRINDER

A complete line of vertical surface grinding machinery to meet every metal finishing requirement. Massive construction, large table capacity, hydraulic operation, automatic wheel feed controls, and central control of all operations, make this a highly efficient machine for production grinding of flat surfaces.



No. 85
HORIZONTAL FACE GRINDER

Increased production at lower costs is the outstanding feature of Bridgeport Face Grinders. A complete line of seven machines for all grinding needs, with table capacities up to 210" x 54". Massive Timken spindle bearings continuously lubricated, and table speeds of 5 to 170 ft. per minute, help to give these machines versatility.



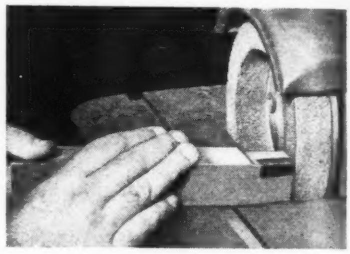
No. 161
FLOOR STAND GRINDER

In sizes from 1 to 15 H. P. to fit all needs. Minimum floor space requirements, carbon steel spindles and large bearings running in oil, explain the popularity of Bridgeport Grinders. Supplied with variable speeds if desired. Other sizes and types of Floor Stand Grinders available.

No. 47W
ABRASIVE CUT-OFF MACHINE

Experience has demonstrated that abrasive wheels cut faster, cooler and cheaper than any other method. The Bridgeport line is complete, including standard machines with capacity up to 3½" on tubing and 2½" on solids; hydraulic semi-automatic machines for larger requirements and rotary cut-off machines for high production cutting.

"BUXITE"

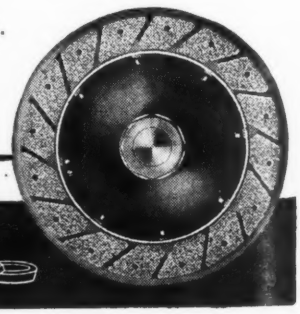


Newest grinding wheel development — gives wheels a "case hardening" that compares favorably with diamond wheel life, and at a fraction of the cost! Grinds sintered carbide tools and other superhard materials with rapidity and wear resistance never before attained with abrasive wheels. Buxite will enable you to recondition all your tools in your own shop.

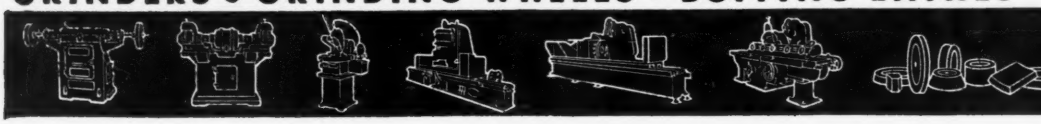
The standard line of "Bridgeport" Grinding Wheels includes all Alumina and Silexon wheels with vitrified, silicate and resinoid bonds—sizes 4" to 30".

THE BRIDGEPORT SAFETY EMERY WHEEL CO., INC. • BRIDGEPORT, CONN., U. S. A.

Bridgeport



GRINDERS • GRINDING WHEELS • BUFFING LATHES



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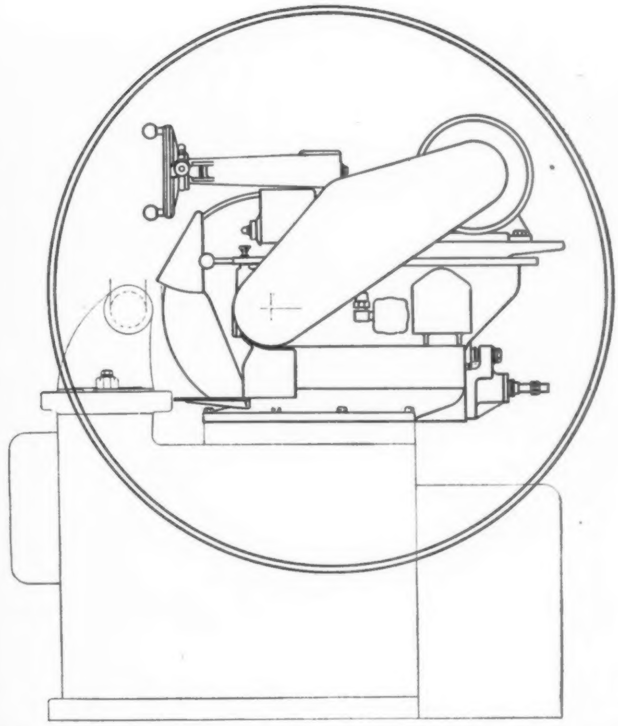
You too can have FITCHBURG *Automatic* PRECISION GRINDING

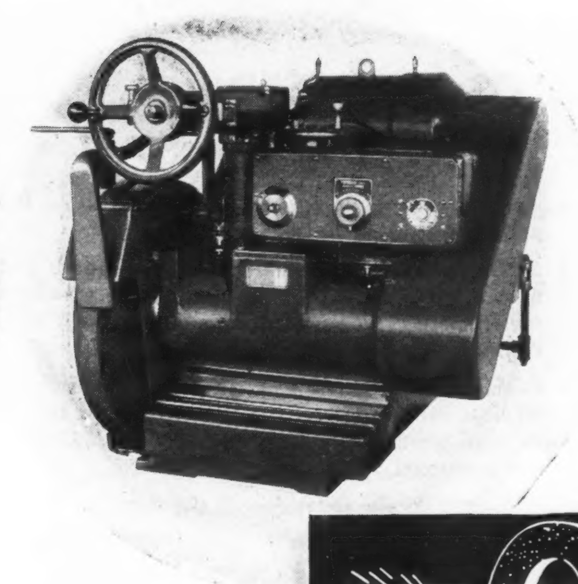


FITCHBURG Bowgage Head mounted on another make of grinding machine

INEXPENSIVELY . . . . *by installing FITCHBURG Bowgage Heads on the Grinders you now have.*

Just as we did in the above case—and in many others—we'll be glad *to prove to your satisfaction* the ease, the simplicity, and the *inexpensiveness* of installing Fitchburg Bowgage Heads on your present grinders. With your grinding equipment thus modernized, the resulting mass production applied to your precision grinding will soon pay off the small cost involved.

The FITCHBURG Bowgage Head is a self-contained grinding unit, with *all* its movements and controls within itself. It has rapid traverse, slow grinding feed, grinding dwell or spark out, and rapid return to starting position—all started by one push button. It is precise to .0002", minimizing spoilage. It can be removed and remounted for other work, if operations are changed—thus protecting your investment in grinding machinery. Fitchburg engineers will welcome the opportunity to help you solve your grinding modernization problem. There is, of course, no charge for this service. Send us the details—blueprints if available—and see how easily and inexpensively *you too* can have FITCHBURG AUTOMATIC PRECISION GRINDING in your shop.



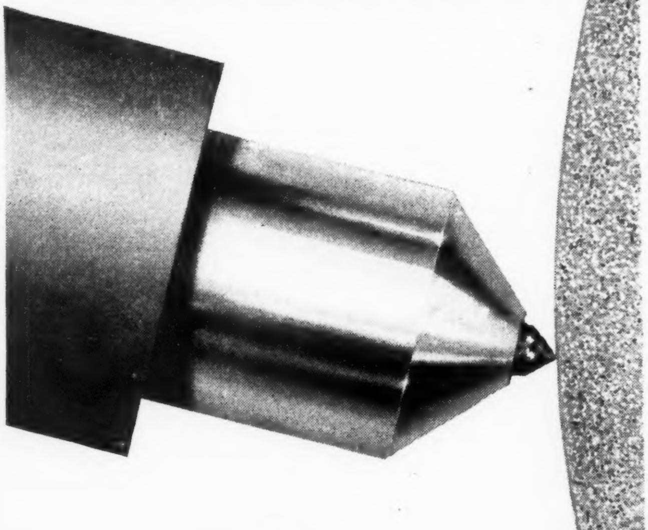
FITCHBURG BOWGAGE HEAD

FITCHBURG GRINDING MACHINE CORP.

FITCHBURG, MASSACHUSETTS, U. S. A.

Manufacturers of—Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Both Full Universal Grinders and Special Purpose Grinders.

For Utmost Precision...



...use Desmond Diamond Tools

THE PLAIN FACT that Desmond makes the only complete line of grinding wheel dressing and truing tools is reason enough for specifying Desmond for all your dressing requirements. But there are other good reasons, too. Take diamond tools. We select rough diamonds with expert care, mount them (in hand tools or nibs) with hard-earned know-how, and *stand behind every single one.*

Fasten your Desmond diamond tools securely in the tool post or holder . . . with the tool axis at an angle of 10 to 15 degrees with respect to the radius . . . and turn the tool frequently to present a new diamond point. As a rule large diamonds run cooler and *do more work per dollar* than small ones.

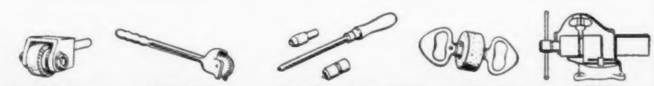
Write for your copy of the Desmond Catalog No. 45 today. It will help you pick the right tool for the job—and get the most out of it.

THE DESMOND-STEPHAN MFG. CO., URBANA, OHIO

Desmond

the only complete line of grinding wheel

DRESSERS & CUTTERS



BALL BEARING DRESSERS | REVOLVING CUTTER TYPE DRESSERS | DIAMOND HAND TOOLS AND NIBS | WHEEL TYPE DRESSERS | SIMPLEX STEEL-SLIDE VISES

when you want Speed— when you want power—

. . . in your job of grinding, polishing, buffing, sanding, drilling, reaming, screw-driving or nut-setting, you want a Strand Flexible Shaft machine, because a Strand will do it faster, better, and stand up to it longer.

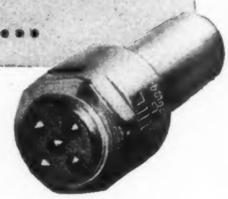
Strand Flexible Shaft machines provide constant speeds with greater operator convenience. Hundreds of attachments easily interchanged—125 types and sizes—models include vertical and horizontal type machines from $\frac{1}{8}$ to 3 h.p. Distributors in all principal cities.

Send today for catalog showing complete line

Strand FLEXIBLE SHAFTS

N. A. STRAND & CO.
5011 NO. WOLCOTT AVE.
CHICAGO 40, ILL.

For speed and economy when roughing or semi-finishing wheels of harder than average bond...



SMITITE CLUSTER DIAMOND TOOLS

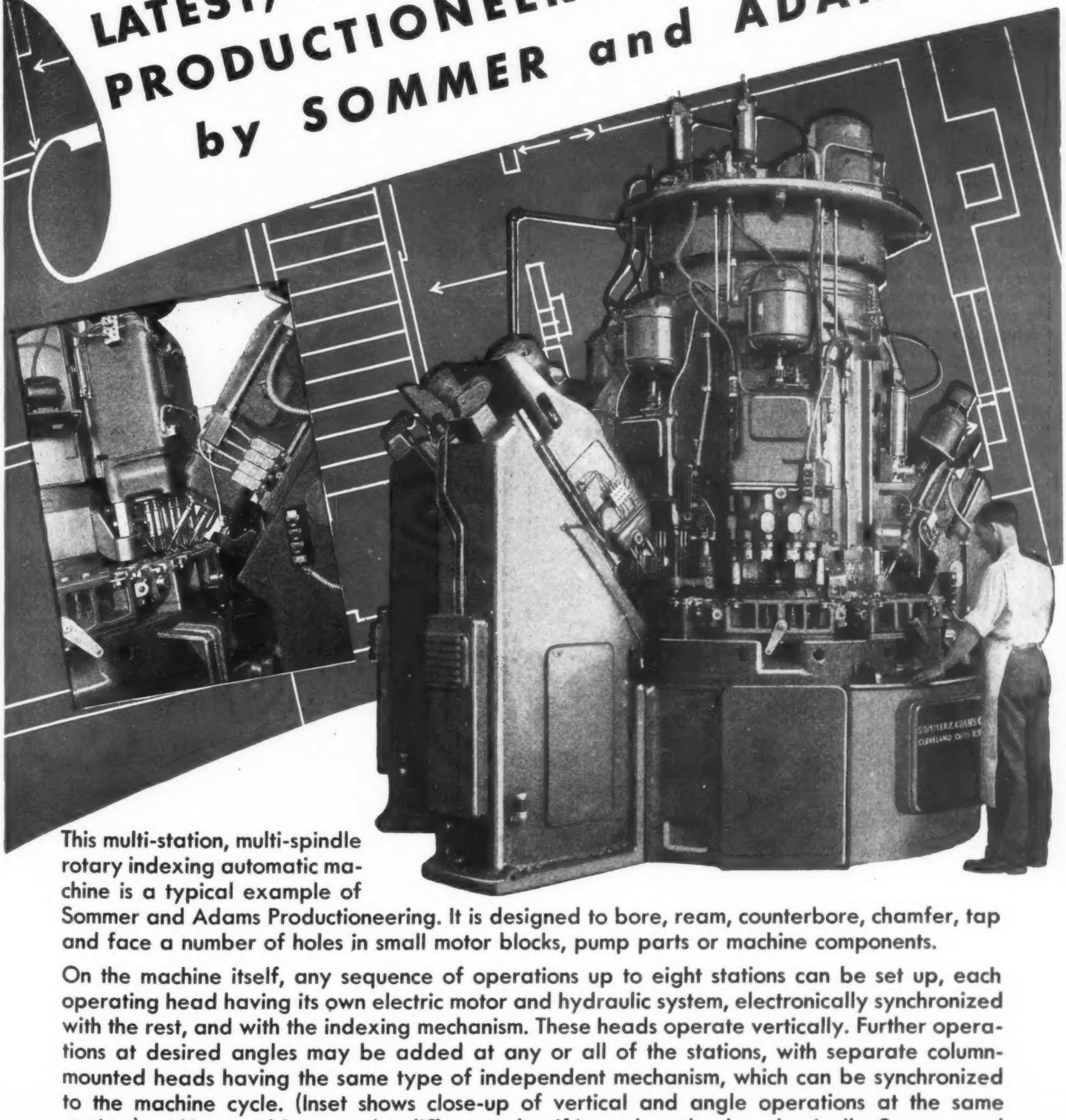
- A variety of tools for a variety of straight face and side dressing finishes.
- 2 to 60 fine grade small whole diamonds permanently set in SMITITE—a patented powdered metal matrix that holds diamonds securely until consumed . . . does not glaze wheel.
- Diamonds are precisely set in planes for the most efficient continuous cutting action. A short turn of the tool presents fresh cutting edges until all stones are consumed. No resetting is required.

Write today for all the facts.

J. K. SMIT & SONS, Inc.

157 Chambers Street, New York 7, N. Y.

LATEST, BUT NOT LAST, PRODUCTIONEERING UNIT by SOMMER and ADAMS



This multi-station, multi-spindle rotary indexing automatic machine is a typical example of Sommer and Adams Productioneering. It is designed to bore, ream, counterbore, chamfer, tap and face a number of holes in small motor blocks, pump parts or machine components.

On the machine itself, any sequence of operations up to eight stations can be set up, each operating head having its own electric motor and hydraulic system, electronically synchronized with the rest, and with the indexing mechanism. These heads operate vertically. Further operations at desired angles may be added at any or all of the stations, with separate column-mounted heads having the same type of independent mechanism, which can be synchronized to the machine cycle. (Inset shows close-up of vertical and angle operations at the same station.) . . . Your problem may be different—but if it can be solved mechanically, Sommer and Adams can build machines to do it.

S&A

THE SOMMER & ADAMS COMPANY

18515 EUCLID AVENUE • CLEVELAND 12, OHIO

Custom-Built EQUIPMENT FOR MANY PURPOSES

SUBSIDIARY OF THE FEDERAL MACHINE AND WELDER COMPANY

KEEP DRILLS *Sharp*

- ACCURACY
- EFFICIENCY
- LONGER LIFE

FOR MAXIMUM PRODUCTION

MORE PERFECT HOLES PER GRIND

OLIVER'S 510 DRILLPOINTER

Covers the entire range of Drills from 1/4" to 3", providing points that give greater clearance with less chisel point angle — thrust is reduced — uniformity maintained — each drill point is exactly the same as every other drill point—Test the Oliver Drill Point on your multiple spindle equipment.

To get maximum efficiency and longer life from Drills depends on proper grinding of the drill point. Drill grinding machines should be used — Drills sharpened on Oliver's Drillpointer give balanced cut with each lip doing equal work. It means longer life to both drills and equipment.

More Holes Per Grind Means Less Cost Per Unit.

OLIVER OF ADRIAN PRODUCTS

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IMPROVE YOUR TOOLROOM
IT'S THE BACKBONE
OF PRODUCTION

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AUTOMATIC DRILL GRINDERS
TOOL & CUTTER GRINDERS—DRILL
POINT THINNERS—TEMPLATE
TOOL GRINDERS—FACE MILL
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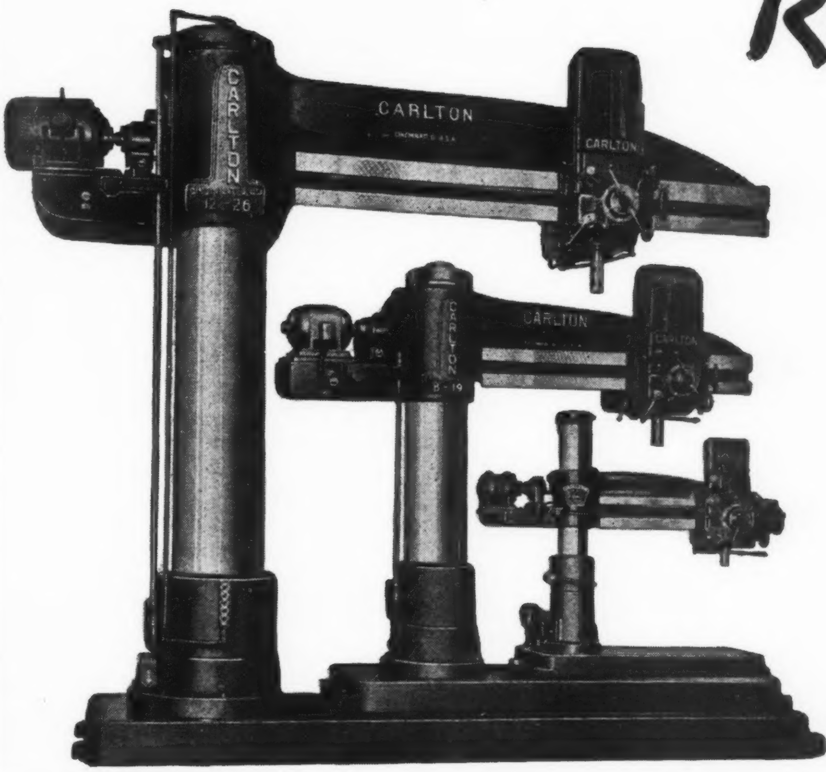
CARLTON *Radials*



The Carlton Machine Tool Co. offers a complete line of Radial Drilling Machines in sizes ranging from 3′ arm to 12′ arm, and from 9″ dia. column to 26″ dia. column. Carlton Radials are delivering outstanding service in almost every large manufacturing plant in the country, as well as railroad shops, shipyards, steel mills, etc. Carlton all-ball-bearing construction with original low-hung drive to spindle makes operation—even under heavy loads — smooth, vibrationless and chatter-proof. Many other modern features available. For greater production, greater economy and satisfaction . . . . investigate Carlton Radials today!

THE CARLTON MACHINE TOOL CO.
CINCINNATI, OHIO

The Drill with a Hundred and One Speeds

All Speeds Instantly Available While Machine Is Running

M-125—3/8 Cap.
M-96—7/8 Cap.
1 to 6 Spindles

Correct speed at the turn of a knob.

Speed Chart on front of head.

Ability to obtain exact speed for diameter of drill and material to be used results in less breakage, fewer grinds and higher efficiency.

•

Write for Circulars.
MM-125 MM-96

THE TAYLOR & FENN CO., Hartford, Conn.

For Man-Hour Savings— For Better, Smoother Work— USE A "HOLE-HOG"

• Boring—rough, semi-finish and finish • Honing • Milling (special machines) • Straight Line Drillers • Universal Adjustable Spindle Drillers • Way Type Machines—horizontal and vertical drilling, tapping and boring machines.

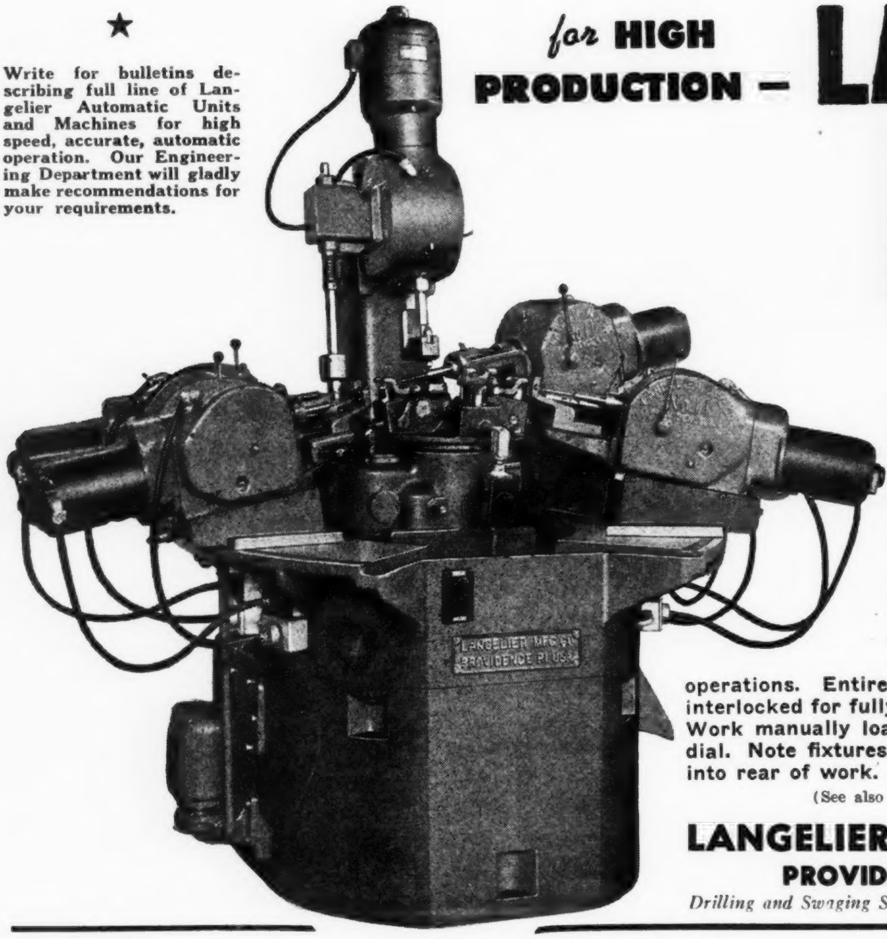
Since 1901, Moline machine tools have been producing better work, continuously, at greater production and man-hour savings. They are ruggedly built and engineered to fit your particular needs, but are easy to change over to other jobs.

Write us for information concerning machine tool equipment for your special problems.

MOLINE TOOL COMPANY
107 20th Street Moline, Illinois

★

Write for bulletins describing full line of Langelier Automatic Units and Machines for high speed, accurate, automatic operation. Our Engineering Department will gladly make recommendations for your requirements.



for HIGH PRODUCTION — LANGELIER

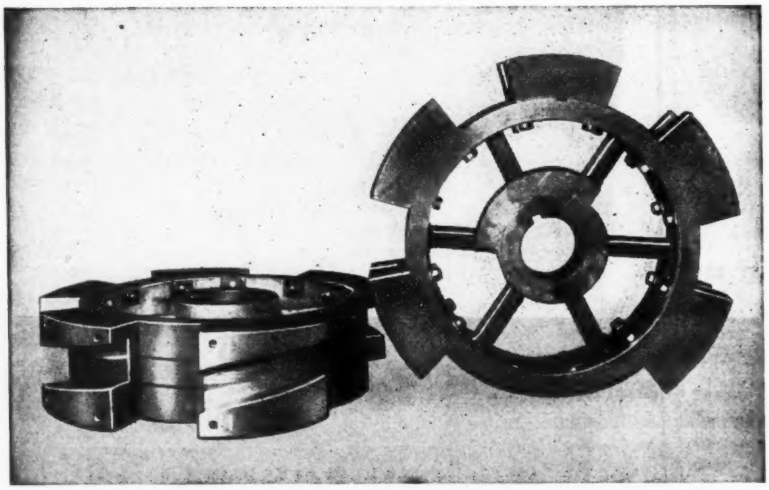
AUTOMATIC UNITS *for* MULTIPLE DRILLING TAPPING ETC.

Speed and efficiency are contributed to multi-operation production by LANGELIER Automatic Units arranged in various combinations. Typical is the Special Machine at left, which handles drilling, grooving, tapping and counterboring operations by means of five Langelier Drilling Units and one Tapping Unit. (Also available: milling, reaming, spotting, chamfering, etc.) Multiple Spindle attachable Langelier heads may be mounted on feed sleeves of each Unit for combinations of these operations. Entire machine, as illustrated, is electrically interlocked for fully automatic operation and central control. Work manually loaded and clamped in fixtures on 4-station dial. Note fixtures mounted at 10° angle to permit drilling into rear of work.

(See also our Swager advertisement in this issue.)

LANGELIER MANUFACTURING CO.
PROVIDENCE • RHODE ISLAND
Drilling and Swaging Specialists for Over 50 Years . . . Incorporated 1887

Rowbottom *for* Cams

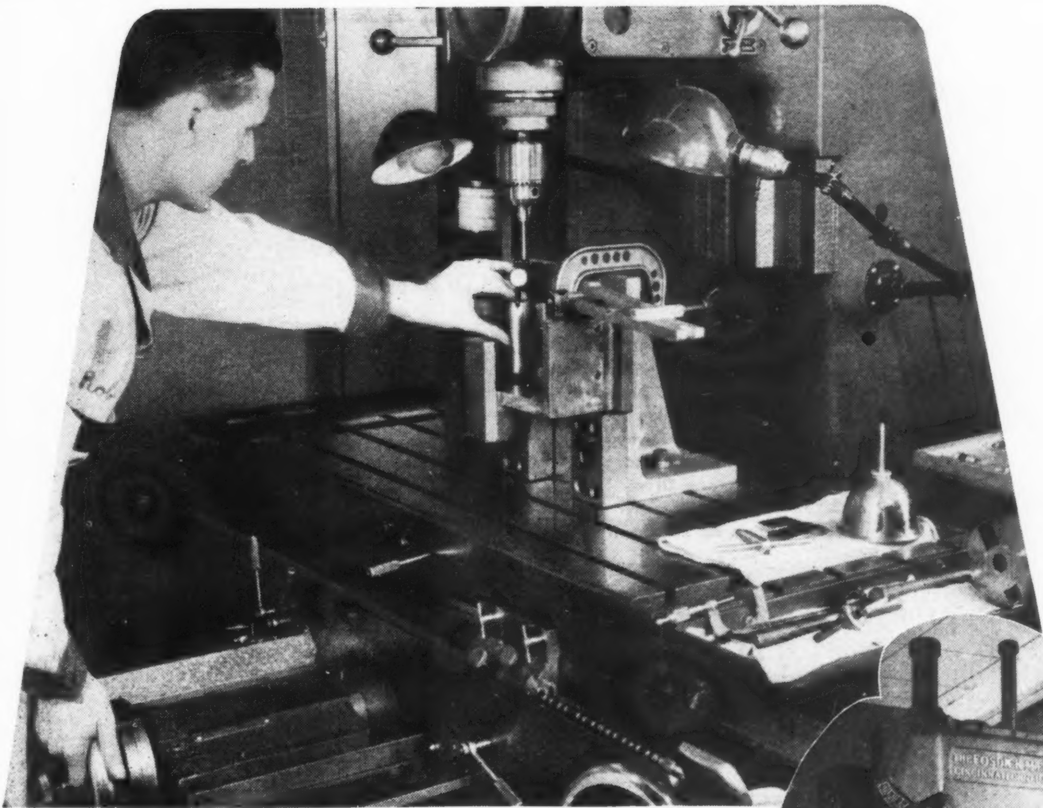


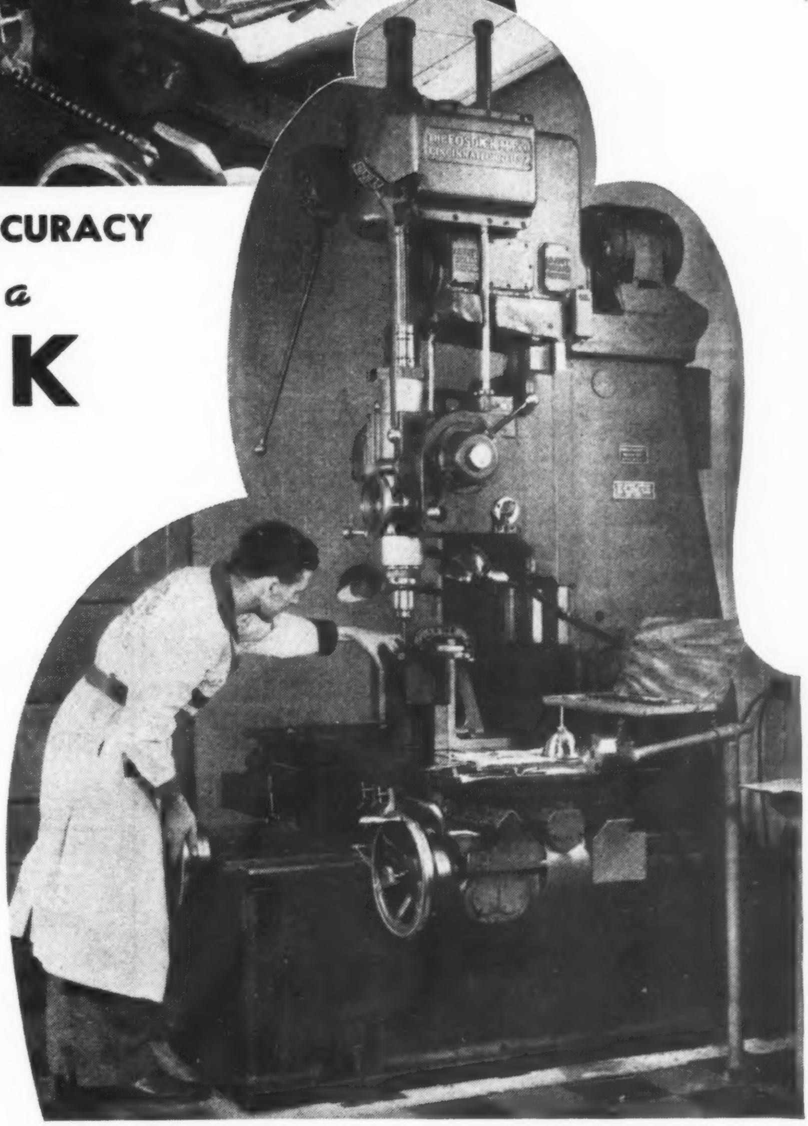
● The cam illustrated – made of interchangeable steel segments – is an example of Rowbottom service in designing and manufacturing cams for unusual applications. For every cam, whatever the material, size, type, or function, get Rowbottom estimates first!

of Every Type and Size

Cams – and cams only! That is why it pays to let Rowbottom handle your problems of cam design and production. Our entire facilities are devoted to cam manufacture only and our experience in this particular field makes Rowbottom the logical choice whenever you need cams.

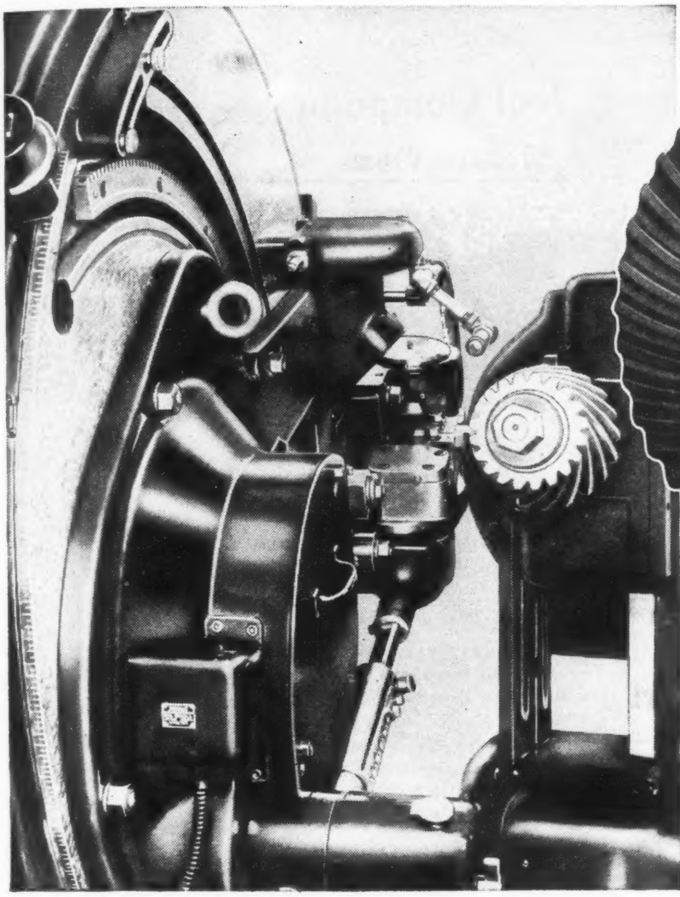
THE ROWBOTTOM MACHINE CO., Waterbury, Conn., U. S. A.

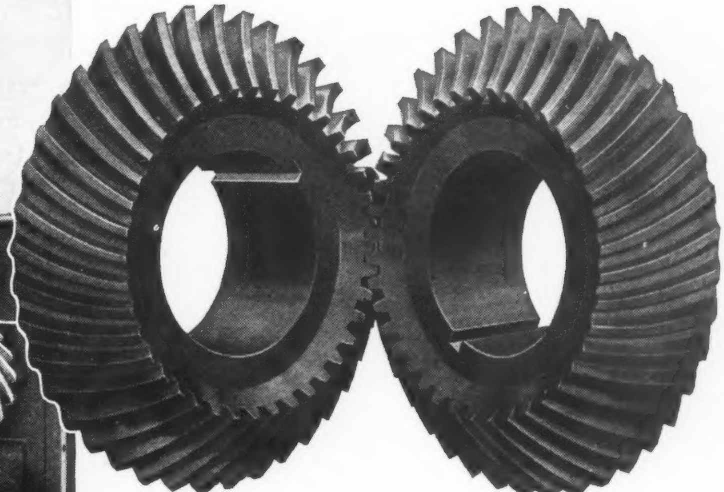




Curved Tooth Spiral Bevels

..THE BEST COMBINATION OF GEARS





....for smoothness, quietness, efficiency, strength & durability

... FOR SHAFTS OPERATING AT ANY ANGLE

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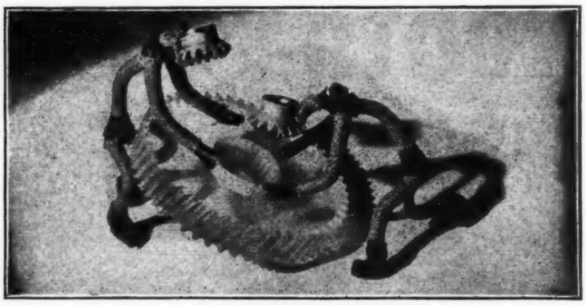

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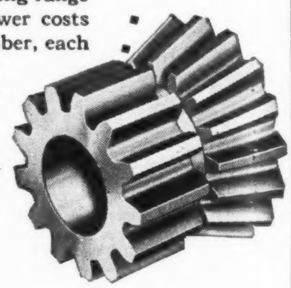

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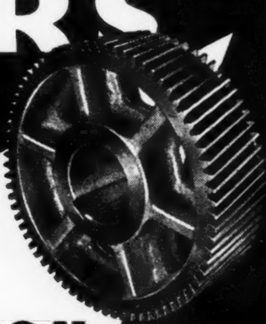

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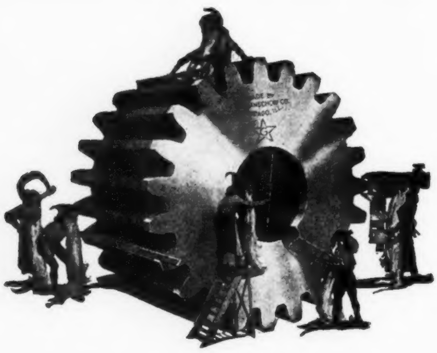

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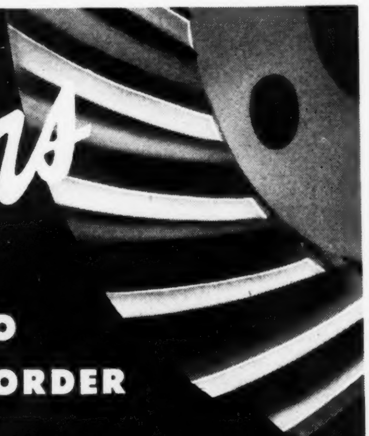

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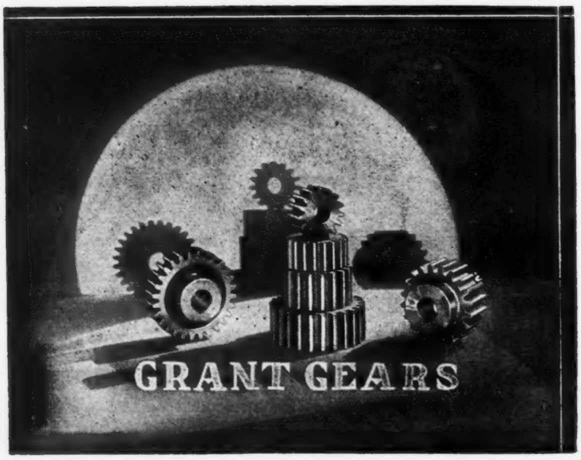

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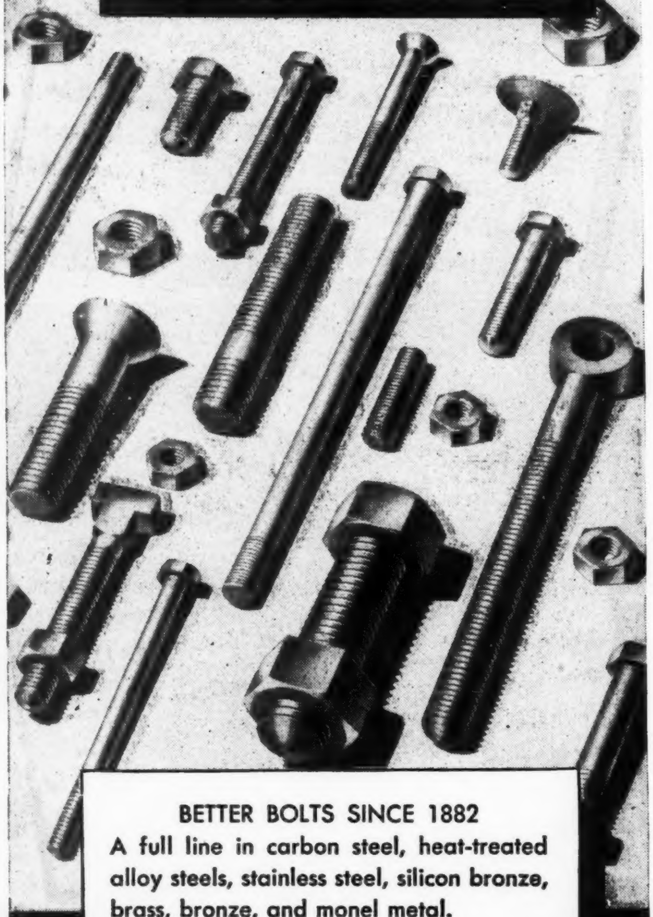

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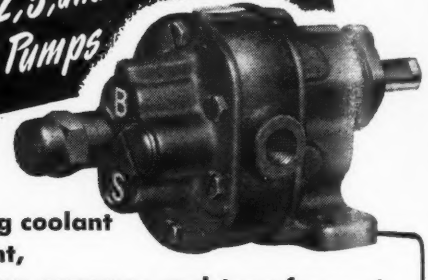

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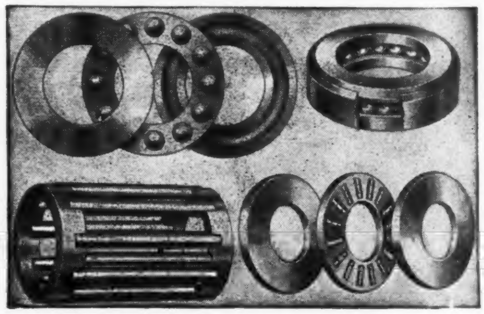

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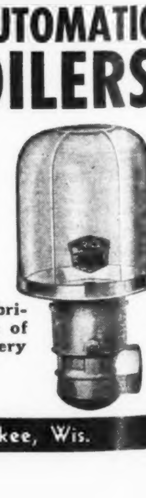

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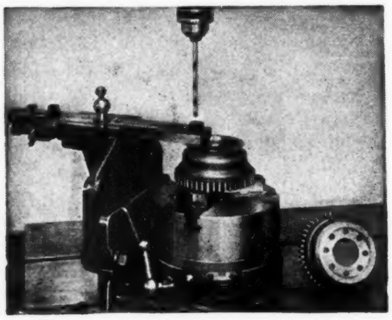

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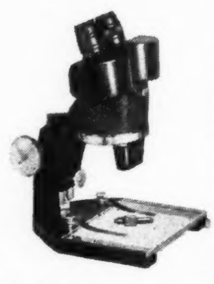

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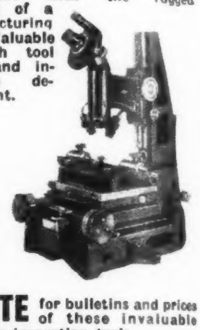

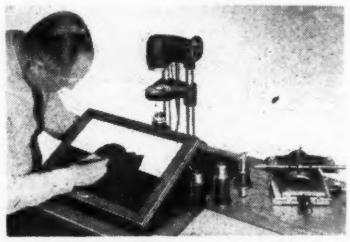

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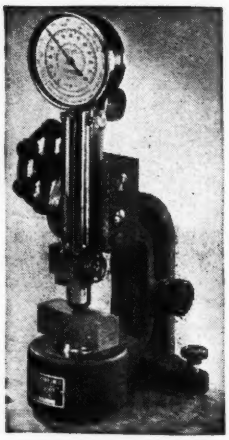

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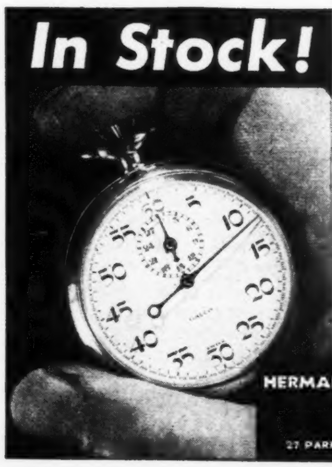

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ALLEN FLAT HEAD CAP SCREWS

set up *flush* in holding thin plates or superposed parts, without weakening the metal with deep countersink.

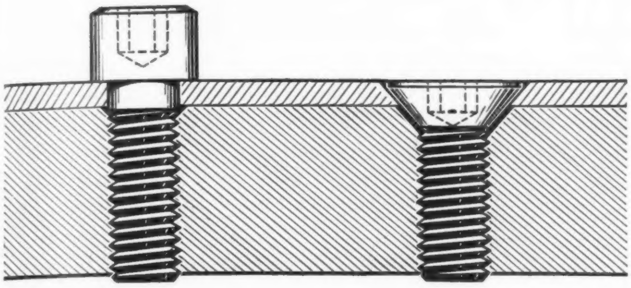
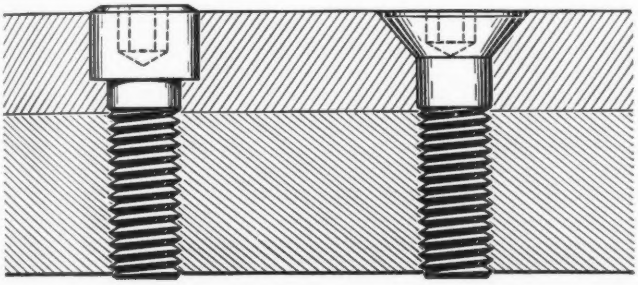


Figure 1, above, (right) shows flush surface achieved in tieing down metal piece thinner than head height of screw.

Figure 2, below, shows advantage in fastening relatively thin plate to retain flush surface without weakening the metal with deep countersink. Note more binding surface under head.



ALLEN USAGE

Here's the way to apply ALLEN holding-power to comparatively thin plates where a flush top surface must be achieved, with no gap between screw head and surrounding metal.

Note that top piece of metal in Figure 1 is thinner than head height of the Flat Head Cap Screw. There's more binding surface under the head than is the case with a projecting-head screw, and the angle helps lock the screw in place by drawing down on a conical surface.

Figure 2 shows application in a comparatively thicker plate. Here the flush surface is retained without weakening the metal with a deep countersink. Maximum strength in the screw itself is assured by "pressur-forming" of special-analysis ALLENOY steel.

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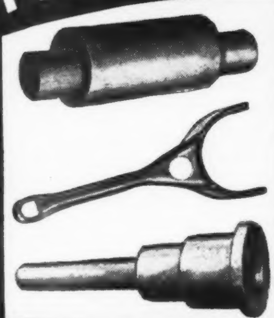

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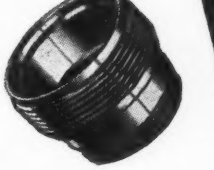
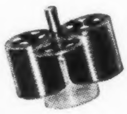


Part: Body — Hollow with Thin Wall

Thread: 2"-12NS

Material: Brass



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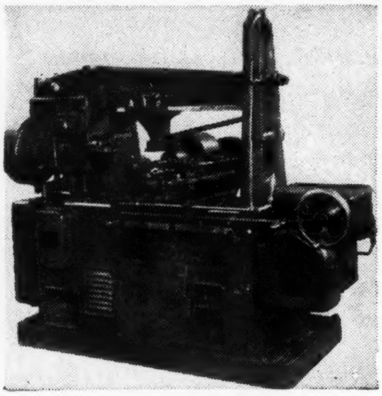

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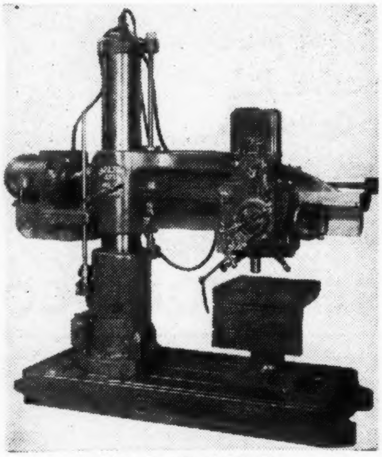

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25"x28' LeBlond Grd. Hd., M.D., taper.
36"x32' American Grd. Hd., 2 carriages, taper, M.D.

GEAR CUTTERS AND HOBBERS

No. 12 Barber-Colman D.O.A. Hobber, M.D.
6" Gleason Str. Bevel Gear Generator, M.D.
60-H Gould & Eberhardt Univ. Hobber, M.D.
10" Pratt & Whitney 2-wheel Gear Grinders, M.D., new in 1941.

GRINDERS

10"x24" Type BA Norton, A.C., M.D.
No. 2, No. 5 and No. 510 Oliver Drill Grinders, M.D.

MILLING MACHINES

No. 2B Milwaukee D.O.A. Plain, M.D.
36" Ohio Production
No. 4 Cincinnati H.P. Plain, Rect. O.A.
No. 1½B Milwaukee Universal, M.D.

RADIAL DRILLS

6" American Triple Purpose, M.D.
6' Cincinnati-Bickford, M.D.
7' Cincinnati-Bickford, M.D.

MISCELLANEOUS

No. 307 Barnes Honing Machine, M.D.
24", 36" & 42" Bullard "New Era" Vertical Turret Lathes.
61" Bullard "Maxi Mill" Vert. Boring Mill.
72" Niles-Bement-Pond Vert. Boring Mill.
No. 45 Giddings & Lewis Horizontal Boring Mill, A.C. M.D.
No. 4A Warner & Swasey Univ. Hollow Hex. Turret Lathes, 9" and 12" hollow spindle, A.C. M.D., latest type.

If machines you need are not listed above, send us your inquiry. We have a very large stock.

Cincinnati Machinery Co., Inc.
217 E. Second St., Cincinnati 2, Ohio

WANTED — DEVELOPMENT ENGINEER

By an outstanding Machine Tool Company, an extremely capable Development Engineer, who may shortly work into the position of Chief Engineer. No ordinary man should apply for this position. The accepted applicant cannot be more than 45 years of age and must evidence, by his record, extreme capability. Address: Box No. 400, MACHINERY, 148 Lafayette Street, New York 13, N. Y.

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Monarch Lathe, 6'x16½"; G.H. Motor in base; 29 collets; good condition.
New Britain Auto. 6-spindle Screw Machine, 7'x1⅝"; many extra collets, box and cutting tools; good condition, reasonable.
Gisholt Turret, 3½" cap.; quick return; motorized.
J & L Turret, Saddle T.; 3"x36"; motorized.
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Cochran Bly 14" Circular Saw, 5" cap., good condition; cheap.
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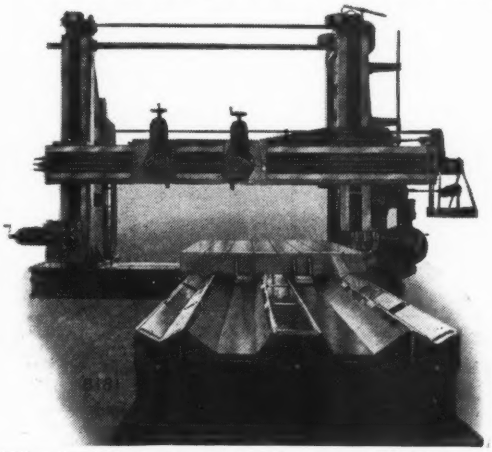
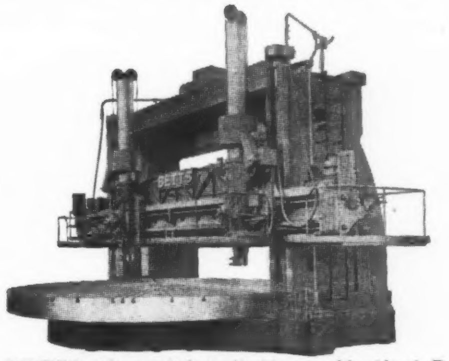
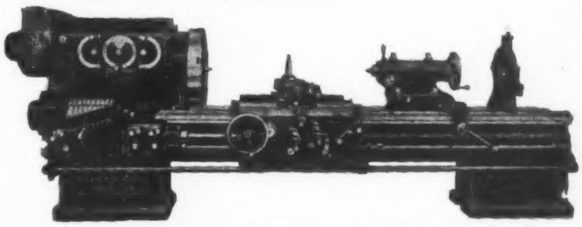


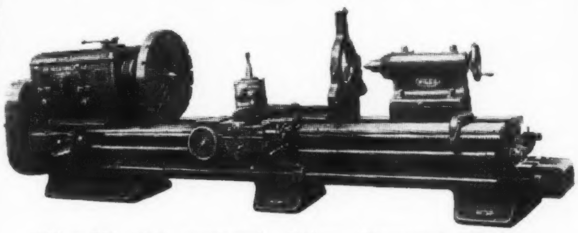
8'6"/14' x 35' Detrick & Harvey (Bethlehem) Convertible Openside Planer, with Three Ways and Double Drive. 100-HP, 230 V, DC Reversing Type Planer Motor and Control. 4-Heads.



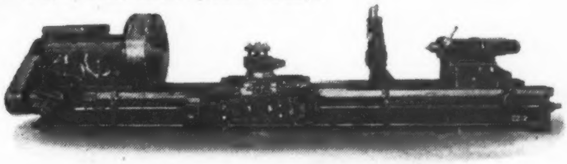
14' BETTS (Consolidated) Heavy Vertical Boring and Turning Mill, with two swivel heads, arranged motor drive with 40-H.P., 230-V, D.C. motor and control (New 1942).



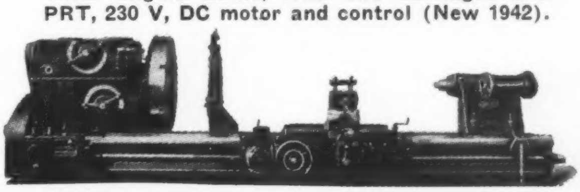
24" x 26' Centers American "High Duty" 12-speed geared head Engine Lathe, apron control, PRT, AC, M.D. (New 1942).



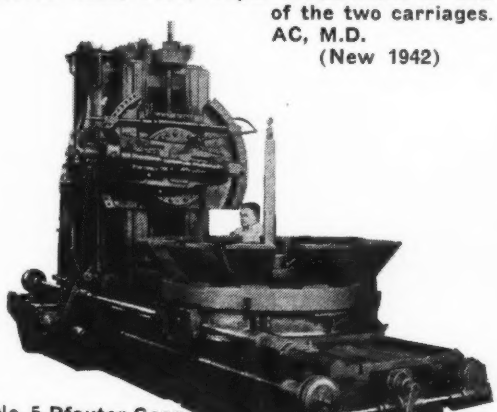
36" x 32' (24' centers), Niles (General Machinery) "TIMESAVER" Engine Lathe. 12-speed geared head, PRT, Taper Attachment to one of the two carriages. AC, M.D. (New 1942)



48" x 40' (30' centers) Simmons Heavy Geared Head Engine Lathe, with two carriages and PRT, 230 V, DC motor and control (New 1942).



48" x 45' (35' centers) Niles (General Machinery) Heavy Engine Lathes. 16-Speed Geared Headstock, Two Carriages with PRT, AC or DC, M.D. (New 1942).
Also available 60" x 31' (20' centers) Niles, 16-Speed G.H. Lathe (New 1942).



No. 5 Pfauter Gear Hobbing Machine, rated capacity 118"; maximum capacity 130"; M.D.

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3' Carlton sensitive
3' Western
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4' Carlton
5' Western

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Model 130 Cleveland Rigidhobber
No. 7 Fellows gear shaper
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18" Gleason lappers & testers
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48" Cincinnati auto. spur

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Nos. 2 & 13 B. & S. universal
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6" x 18" Norton hydraulic
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10" x 24", 16" x 36" & 16" x 72" Landis
Nos. 75A & 72A3 Heald internal
No. 115 Gardner opposed disc
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No. 3 Abrasive surface
16", No. 10 Blanchard surface
12" x 24" Diamond surface

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14" x 6' Hendey
14" x 6' Leblond
14" x 6' & 16" x 6' American
16" x 12'6" Reed Prentice
18" x 8' Springfield
36" x 16' Bridgeford

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96" Cincinnati Massive Pattern
60" Colburn
53" Niles Bement Pond
42" & 24" Bullard V.T.L.
5" Barrett cylinder borer
6 spdl. 10D Moline borer

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No. 3B Brown & Sharpe
No. 3S Cincinnati
No. 3 Reed Prentice vertical
No. 2½B Milwaukee vertical
No. 4 Cincinnati H.P. vertical
Nos. 4-36 & 4-48 Cincinnati Hydromatic
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30" & 48" Newton rotary
Ingersoll drum type duplex
No. 1 Davis Thompson duplex
12" Cincinnati plain mfg.
No. 4 Lees Bradner Univ. thread
Type C Hall planetary thread
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For addresses of manufacturers listed, consult advertisements in this and previous issue. ***Index Pages 467-468***

ABRASIVE CLOTH AND PAPER
Carborundum Co.
Walls Sales Corp.

ABRASIVE DISCS
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ABRASIVES, POLISHING
Carborundum Co.
Norton Co.

ACCUMULATORS, Hydraulic
Baldwin-Southwark Corp.
Bethlehem Steel Co.
Elmes Engineering Works
Farquhar, A. B., Co.
Farrel-Birmingham Co., Inc.
Hydropress Co., Inc.
Lake Erie Engineering Corp.
Morgan Engineering Co.
Watson-Stillman Co.

AIR HOISTS—See Hoists, Air.

AIR TOOLS—See Grinders, Pneumatic; Drills, Portable Pneumatic, etc.

ALLOYS FOR DIES
National Lead Co.

ALLOY-STEELS
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carnegie-Illinois Steel Corp., (U. S. Steel Corp. Div.)
Carpenter Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Frasse, Peter A., & Co., Inc.
Ingersoll Steel Div., Borg-Warner Corp.
Republic Steel Corp., (Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.
Vanadium Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

ALLOYS, ALUMINUM
Aluminum Co. of America

ALLOYS, NON-FERROUS
American Brass Co.

ARBOR PRESSES
See Presses, Arbor.

ARBORS AND MANDRELS
Anker-Holth Mfg. Co.
Brown & Sharpe Mfg. Co.
Cleveland Twist Drill Co.
[illegible] Specialties, Inc.
Hannifin Mfg. Co.
Jacobs Mfg. Co.
Kempsmith Mch. Co.
Morse Twist Drill & Mch. Co.
National Tool Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Scully-Jones & Co.
Standard Tool Co.
Union Twist Drill Co.

BABBITT
Besly, Chas. H., & Co.
Bunting Brass & Bronze Co.
Cramp Brass & Iron Fdrs. Div.
Johnson Bronze Co.
Ryerson, Joseph T., & Son, Inc.

BALANCING EQUIPMENT
Anderson Bros. Mfg. Co.
Gisholt Machine Co.
Ideal Industries, Inc.
Norton Co.
Pope Machinery Corp.
Sundstrand Mch. Tool Co.
Taylor Mfg. Co.

BALLS, Brass, Steel, Etc.
Gwilliam Co.
S K F Industries, Inc.

BARS, Boring
See Boring Bars.

Phosphor Bronze
Bunting Brass & Bronze Co.
Johnson Bronze Co.

Steel
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Frasse, Peter A., & Co., Inc.
Jones & Laughlin Steel Corp.
Republic Steel Corp., (Union Drawn Steel Div.)
Rustless Iron & Steel Div., American Rolling Mills Co.
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
Ward Steel Co.
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BASES, Machinery, Welded
Mahon, R. C., Co.

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Bunting Brass & Bronze Co.
Hill Acme Co.
Johnson Bronze Co.

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Atlantic Gear Works, Inc.
Ball & Roller Bearing Co.
Bantam Bearings Div.
Bearings Co. of America
Boston Gear Works, Inc.
Equitable Bearing Co., Inc.
Federal Bearings Co., Inc.
Gwilliam Co.
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McGill Manufacturing Co.
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Norma-Hoffmann Bearings Corp.
Schatz Mfg. Co.
S K F Industries, Inc.
Torrington Co.

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Besly, Chas. H., & Co.
Bunting Brass & Bronze Co.
Haynes Stellite Co.
Johnson Bronze Co.

Lineshaft
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S K F Industries, Inc.
Standard Pressed Steel Co.

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Bantam Bearings Div.
Norma-Hoffmann Bearings Corp.
Orange Roller Bearing Co., Inc.
Torrington Co.

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Equitable Bearing Co., Inc.
Gwilliam Co.
Hyatt Bearings Div., General Motors Sales Corp.
Kaydon Engineering Corp.
L & S Bearing Co.
McGill Manufacturing Co.
Norma-Hoffmann Bearings Corp.
Orange Roller Bearing Co., Inc.
Roller Bearing Co. of America
Rollway Bearing Co., Inc.
S K F Industries, Inc.
Timken Roller Bearing Co.

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Johnson Bronze Co.
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Manhattan-Rubber Div.

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Heim Co.

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Kaydon Engineering Corp.
Raybestos-Manhattan, Inc.
Manhattan-Rubber Div.
Orange Roller Bearing Co., Inc.
Timken Roller Bearing Co.

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Ball & Roller Bearing Co.
Bantam Bearings Div.
Bearings Co. of America
Boston Gear Works, Inc.
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General Electric Co.
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Norma-Hoffmann Bearings Corp.
Orange Roller Bearing Co., Inc.
Timken Roller Bearing Co.

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Raybestos-Manhattan, Inc.,
Manhattan-Rubber Div.

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Raybestos-Manhattan, Inc.,
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Modern Tool Works
New Britain-Gridley Mch. Div.,
New Britain Machine Co.
Oster Manufacturing Co.

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Bethlehem Steel Co.
Elastic Stop Nut Corp. of America
National Acme Co.
Pawtucket Mfg. Co.
Republic Steel Corp.,
(Union Drawn Steel Div.)

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Barnes Drill Co.
Barnes, W. F., & John, Co.
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Cosa Corp.
Foote-Burt Co.
Gorton, George, Mch. Co.

Ingersoll Milling Mch. Co.
Jones Machine Tool Wks., Inc.
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National Acme Co.
National Automatic Tool Co.
Pedrick Tool & Mch. Co.
Rogers Machine Works, Inc.
Sellers, Wm., & Co., Inc.

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Cincinnati Planer Co.
Cosa Corp.
Jones Machine & Tool Works, Inc.
Rogers Machine Works, Inc.
Sellers, Wm., & Co., Inc.

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Bullard Company
Carboloy Co., Inc.
Ex-Cell-O Corp.
Firth-Sterling Steel Co.

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Gisholt Machine Co.
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Williams, J. H., & Co.

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Ingersoll Milling Mch. Co.
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National Automatic Tool Co.
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Sellers, Wm., & Co., Inc.
Sommer & Adams Co.
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Ex-Cell-O Corp.
Gairing Tool Co.
McCrosky Tool Corp.

BORING HEADS, Offset

Gairing Tool Co.

BORING MACHINES, Diamond and Carbide Tool

Ex-Cell-O Corp.
Heald Machine Co.
National Automatic Tool Co.
Stokerunit Corp.

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Fosdick Machine Tool Co.
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Gisholt Mch. Co.
Haynes Stellite Co.
Jones & Lamson Mch. Co.
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McCrosky Tool Corp.
Morse Twist Drill & Mch. Co.
Ready Tool Co.
Scully-Jones & Co.
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National Broach & Mch. Co.

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Cincinnati Milling Mch. Co.
Colonial Broach Co.
Consolidated Mch. Tool Corp.
Foote-Burt Co.
Lapointe Machine Tool Co.
National Broach & Mch. Co.
Oilgear Co.

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Gardner Machine Co.
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Hannifin Mfg. Co.
Lake Erie Engineering Corp.
Watson-Stillman Co.

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Boston Gear Works, Inc.
Bunting Brass & Bronze Co.
Haynes Stellite Co.
Johnson Bronze Co.

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Danly Machine Specialties, Inc.
Leland-Gifford Co.
U. S. Steel Co., Inc.

Jig

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Colonial Broach Co.
Ex-Cell-O Corp.
Universal Engineering Co.

CABINETS, Tool

Armstrong Brothers Tool Co.

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Starrett, L. S., Co.

CAM CUTTING MACHINES

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Pratt & Whitney Co.

CAM MILLING AND GRINDING MACHINES

Rowbottom Machine Co.

CAMS

Hartford Special Mchry. Co.
Kux Machine Co.
Rowbottom Machine Co.
Vinco Corporation

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Firth-Sterling Steel Co.
Kennametal, Inc.
Metal Carbides Corp.
Vanadium Alloys Steel Co.

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Williams, J. H., & Co.

CASE-HARDENING FURNACES
See Furnaces, Heat Treating.

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(Brass and Bronze only)
Bunting Brass & Bronze Co.
Cramp Brass & Iron Foundries Div.

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American Brass Co.
Madison-Kipp Corporation
Veeder-Root, Inc.

Gray Iron
Bethlehem Steel Co.
Brown & Sharpe Mfg. Co.
Union Mfg. Co.

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American Brake Shoe Co.
Bethlehem Steel Co.
Birdsboro Steel Fdry. & Mch. Co.
Cramp Brass & Iron Foundries Div.
Lebanon Steel Foundry.

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Hendey Machine Co.
Walls Sales Corp.

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Firth-Sterling Steel Co.
Ideal Industries, Inc.
Kennametal, Inc.
Morse Twist Drill & Mch. Co.
Scully-Jones & Co.
Standard Tool Co.

Planer & Miller
Cincinnati Planer Co.

CHAIN DRIVES
Morse Chain Co.

CHAINS, Power Transmission and Conveyor
Boston Gear Works, Inc.
Philadelphia Gear Works

CHAMFERING MACHINES, Gear Tooth
Bilgram Gear & Mch. Works
Consolidated Mch. Tool Corp.
Cross Co.
Grant Mfg. & Mch. Co.
Lipe-Rollway Corp.

CHARTS, MEASUREMENT
Capell Engrg. Co.

CHISELS AND CHISEL BLANKS
Bethlehem Steel Co.

CHUCKING MACHINES
Baird Machine Co.
Bardons & Oliver, Inc.
Bliss, E. W., Co.
Bullard Company
Cleveland Automatic Machine Co.
Gisholt Machine Co.
Goss & DeLeeuw Mch. Co.
Heald Machine Co.
Jones & Lamson Machine Co.
National Acme Co.
New Britain-Gridley Mch. Div.
Potter & Johnston Mch. Co.
Sundstrand Mch. Tool Co.
Warner & Swasey Co.

Multiple Spindle
Goss & DeLeeuw Mch. Co.
National Acme Co.
New Britain-Gridley Mch. Div.

CHUCKS
Air Operated
Anker-Holth Mfg. Co.
Hannifin Mfg. Co.
Schrader's Son, A.
Skinner Chuck Co.
Union Mfg. Co.

Collet or Split
See Collets.

Diaphragm
Van Norman Co.

Drill
Cleveland Twist Drill Co.
Ettco Tool Co.
Jacobs Mfg. Co.
McCrosky Tool Corp.
Modern Tool Works
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Procunier Safety Chuck Co.
Scully-Jones & Co.
Skinner Chuck Co.
Standard Tool Co.
Taylor Mfg. Co.
Union Mfg. Co.

Full Floating
Errington Mechanical Laboratory
Gisholt Mch. Co.
Scully-Jones & Co.

Lathe, Etc.

Anker-Holth Mfg. Co.
Bullard Company
Cushman Chuck Co.
Gisholt Mch. Co.
Jones & Lamson Mch. Co.
Rivett Lathe & Grinder, Inc.
Scherr, George, Co., Inc.
Skinner Chuck Co.
Union Mfg. Co.
Warner & Swasey Co.

Magnetic

Arter Grinding Machine Co.
Brown & Sharpe Mfg. Co.
Hanchett Mfg. Co.
Taft-Peirce Mfg. Co.
Walker, O. S., Co., Inc.

Quick Change and Safety

Errington Mechanical Laboratory
McCrosky Tool Corp.
Modern Tool Works
National Tool Co.
Procunier Safety Chuck Co.
Scully-Jones & Co.

Ring Wheel

Bridgeport Safety Emery Wheel Co., Inc.
Gardner Machine Co.

Tapping

Barber-Colman Co.
Errington Mechanical Laboratory
Greenfield Tap & Die Corp.
Jacobs Mfg. Co.
McCrosky Tool Corp.
Procunier Safety Chuck Co.
Scully-Jones & Co.
Skinner Chuck Co.

CIRCUIT BREAKERS

General Electric Co.
Westinghouse Electric Corp.

CLAMPS

Armstrong Brothers Tool Co.
Baumbach, E. A., Mfg. Co.
Besly, Chas. H., & Co.
Brown & Sharpe Mfg. Co.
Danly Machine Specialties, Inc.
Starrett, L. S., Co.
Williams, J. H., & Co.

CLEANERS, Chemical, for Metal

Bullard Co., Bullard-Dunn Process Div.
Oakite Products, Inc.

CLUTCHES

Barnes Drill Co.
Clearing Mch. Corp.
Farrel-Birmingham Co., Inc.
Foote Bros. Gear & Machine Corp.
Hilliard Corp.
Johnson, Carlyle, Machine Co.
Lipe-Rollway Corp.
Morse Chain Co.
Rockford Clutch Div.
Twin Disc Clutch Co.

COATINGS, PROTECTIVE

Bakelite Corp.
Bullard Co., Bullard-Dunn Process Div.

COLLARS, Safety

Standard Pressed Steel Co.

Spacings, Etc.

Scully-Jones & Co.

COLLETS

Ames, B. C., Co.
Anker-Holth Mfg. Co.
Brown & Sharpe Mfg. Co.
Cleveland Twist Drill Co.
Gisholt Mch. Co.
Hannifin Mfg. Co.
Hardinge Brothers, Inc.
Jones & Lamson Mch. Co.
Modern Tool Wks.
New Britain-Gridley Mch. Div.,
New Britain Machine Co.
Pratt & Whitney Co.
Rivett Lathe & Grinder, Inc.
Scully-Jones & Co.
Standard Tool Co.
Stark Tool Co.
Union Twist Drill Co.
Universal Engineering Co.
Warner & Swasey Co.

COMPARATORS—

See Gages, Comparator.

COMPARATORS, Screw Thread

Bausch & Lomb Optical Co.
Jones & Lamson Mch. Co.
Scherr, George, Co., Inc.
Triplex Machine Tool Corp.

COMPOUNDS

Cleaning

Oakite Products, Inc.

Cutting, Grinding, Metal Drawing, Etc.

Cities Service Oil Co.
Gulf Oil Corp.
National Broach & Mch. Co.
(Broaching and Lapping)
Oakite Products, Inc.
Shell Oil Co., Inc.
Standard Oil Co., (Indiana)
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

Resin or Molding

Bakelite Corp.
General Electric Co.

COMPRESSORS, Air

DeLaval Steam Turbine Co.
Ingersoll-Rand Co.

CONTRACT WORK

Adams Stamping Co.
American Measuring Instruments Corp.
Bliss, E. W., Co.
Columbus Die, Tool & Mch. Co.
Diefendorf Gear Corp.
Ex-Cell-O Corp.
Hartford Special Mchry. Co.
Hill Acme Co.
Jack & Heintz Precision Industries, Inc.
Kaydon Engrg. Corp.
Langelier Mfg. Co.
LeBlond, R. K., Mch. Tool Co.
Mummert-Dixon Co.
National Acme Co.
Rockford Machine Tool Co.
Taft-Peirce Mfg. Co.
U. S. Tool Co., Inc.

CONTROLLERS

Allen-Bradley Co.
Bristol Co.
Clark Controller Co.
General Electric Co.
Westinghouse Electric Corp.

COUNTERBORES

Carboloy Co., Inc.
Cleveland Twist Drill Co.
Continental Tool Works Div.
Ex-Cell-O Corporation
Firth-Sterling Steel Co.
Gairing Tool Co.
Genesee Tool Co.
Haynes Stellite Co.
Kennametal, Inc.
Morse Twist Drill & Mch. Co.
National Tool Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Scully-Jones & Co.
Standard Tool Co.
Starrett, L. S., Co.
Union Twist Drill Co.

COUNTERSHAFTS

LeBlond, R. K., Mch. Tool Co.
Standard Pressed Steel Co.
Warner & Swasey Co.

COUNTERSINKS

Ex-Cell-O Corp.
Gairing Tool Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Scully-Jones & Co.
Standard Tool Co.
Union Twist Drill Co.

COUNTERS, Revolution

Bristol Co.
Brown & Sharpe Mfg. Co.
Starrett, L. S., Co.
Veeder-Root, Inc.

COUNTING DEVICES

Starrett, L. S., Co.
Veeder-Root, Inc.

COUPLINGS

Flexible

Atlantic Gear Works, Inc.
Boston Gear Works, Inc.
Eberhardt-Denver Co.
Farrell-Birmingham Co., Inc.
Foote Bros. Gear & Machine Corp.
James, D. O., Mfg. Co.
Lovejoy Flexible Coupling Co.
Morse Chain Co.

Philadelphia Gear Works

Pipe, Tubes, Etc.

Dart, E. M., Mfg. Co.

Shaft

Boston Gear Works, Inc.
Foote Bros. Gear & Machine Corp.
Hilliard Corp.
Sellers, Wm., & Co., Inc.
Standard Pressed Steel Co.

CRANES, Electric Traveling

Morgan Engineering Co.
Shepard Niles Crane & Hoist Corp.

Hand Traveling

Shepard Niles Crane & Hoist Corp.

Locomotives

Cullen-Friestedt Co.
Hill Acme Co.

Portable

Canedy-Otto Mfg. Co.

CUTTER GRINDERS

See Grinding Machines, Universal, for Sharpening Cutters, Reamers, Hobs, Etc.

CUTTERS, Gear

Brown & Sharpe Mfg. Co.
Ex-Cell-O Corp.
Fellows Gear Shaper Co.
Michigan Tool Co.
Morse Twist Drill & Mch. Co.
National Broach & Mch. Co. (Gear Shaper)
National Tool Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Standard Tool Co.
Union Twist Drill Co.
Waltham Mch. Wks.

Milling

Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Carboloy Co., Inc.
Columbus Die, Tool & Machine Co.
Continental Tool Works Div.
Detroit Tap & Tool Co.
Ex-Cell-O Corp.
Firth-Sterling Steel Co.
Gairing Tool Co.
Gammons-Hoaglund Co.
Genesee Tool Co.
Gorton, George, Mch. Co.
Haynes Stellite Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Kennametal, Inc.
McCrosky Tool Corp.
Modern Tool Wks.
Morse Twist Drill & Mch. Co.
National Tool Co.
National Twist Drill & Tool Co.
Nelco Tool Co.
Pratt & Whitney Co.
Producto Machine Co.
Reed-Prentice Corp.
Scully-Jones & Co.
Standard Tool Co.
Union Twist Drill Co.

CUTTING COMPOUNDS

See Compounds, Cutting, Grinding, Etc.

CUTTING-OFF MACHINES

Avey Drilling Machine Co.
Bardons & Oliver, Inc.
Bridgeport Safety Emery Wheel Co., Inc.
Brown & Sharpe Mfg. Co.
Consolidated Mch. Tool Corp.
Landis Machine Co.

Abrasive Wheel

Armstrong Brothers Tool Co.
Bridgeport Safety Emery Wheel Co., Inc.
Campbell, Andrew C., Div. American Chain & Cable Co., Inc.
Delta Mfg. Div. Rockwell Mfg. Co.

Cold Saw

See Sawing Machines, Circular.

CUTTING-OFF TOOLS

Armstrong Brothers Tool Co.
Empire Tool Co.
Firth-Sterling Steel Co.
Haynes Stellite Co.
Luers, J. Milton
Pratt & Whitney Co.
Williams, J. H., & Co.

CUTTING-OFF WHEELS, Abrasive

Bay State Abrasive Co.
Carborundum Co.
Norton Co.
Raybestos-Manhattan, Inc., Manhattan-Rubber Div.

CYLINDER BORING MACHINES

Baker Brothers, Inc.
Barnes Drill Co.
Consolidated Mch. Tool Corp.
Cross Co.
Ex-Cell-O Corp.
Ingersoll Milling Mch. Co.
Moline Tool Co.
Sellers, Wm., & Co., Inc.

CYLINDERS, Hydraulic

American Hollow Boring Co.
Anker-Holth Mfg. Co.
Barnes, John S., Corp.
Clearing Mch. Corp.
Denison-Engineering Co.
Galland-Henning Mfg. Co.
Hanna Engrg. Works
Hannifin Mfg. Co.
Hydraulic Press Mfg. Co.

Hydraulic Products Co.
Oilgear Co.
Rockford Machine Tool Co.
Skinner Chuck Co.

Pneumatic

Anker-Holth Mfg. Co.
Clearing Mch. Corp.
Hanna Engrg. Works
Hannifin Mfg. Co.
Hydraulic Products Co.
Skinner Chuck Co.

DEALERS, Machinery

Besly, Chas. H., & Co.
Earle Gear & Mch. Co.
Lunden & Bonthron
Ryerson, Joseph T., & Son, Inc.
Simmons Machine Tool Corp.

DEMAGNETIZERS

Blanchard Mch. Co.
Heald Machine Co.
Ideal Industries, Inc.
Walker, O. S., Co., Inc.

DESIGNERS, Machine and Tool

Ex-Cell-O Corp.
Hartford Special Mchry. Co.
Ruthman Mchry. Co.
Vinco Corporation

DIAMONDS and Diamond Tools

Bausch & Lomb Optical Co.
Desmond-Stephan Mfg. Co.
Raybestos-Manhattan, Inc.,
Manhattan-Rubber Div.
Smit, J. K., & Co.

DIE CASTING MACHINES

Hydraulic Press Mfg. Co.
Kux Machine Co.
Madison-Kipp Corp.
Reed-Prentice Corp.

DIE CASTING

See Castings, Die.

DIE CUSHIONS, Pneumatic

Bliss, E. W., Co.
Clearing Mch. Corp.
Verson Allsteel Press Co.

DIE INSERTS, Carbide

Carboloy Co., Inc.
Firth-Sterling Steel Co.
Kennametal, Inc.

DIE MAKERS' SUPPLIES

Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
U. S. Tool Company, Inc.

DIE MAKING MACHINES

Grob Brothers
Kearney & Trecker Corp.
Oliver Instrument Co.

DIE SETS, Standard

Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
Pratt & Whitney Co.
Producto Machine Co.

DIE SINKING MACHINES

Cincinnati Milling Mch. Co.
Gorton, George, Mch. Co.
Pratt & Whitney Co.
Reed-Prentice Corp.

DIE SINKING PRESSES

Baldwin-Southwark Corp.
Kearney & Trecker Corp.

DIE STOCKS

See Stocks, Die.

DIES, Lettering and Embossing

Noble & Westbrook Mfg. Co.
Sossner, Inc.

DIES

Sheet Metal, Etc.

Baumbach, E. A., Mfg. Co.
Bliss, E. W., Co.
Columbus Die, Tool & Mch. Co.
Niagara Mch. & Tool Wks.
Peck, Stow & Wilcox Co.
Ruthman Mchry. Co.
Taft-Peirce Mfg. Co.
Verson Allsteel Press Co.
V & O Press Co.
Waltham Mch. Wks.

Threading

Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Eastern Mch. Screw Corp.
Geometric Tool Co.
Greenfield Tap & Die Corp.
Hill Acme Co.
Jones & Lamson Mch. Co.
Landis Mch. Co., Inc.
Modern Tool Works
Morse Twist Drill & Mch. Co.
National Acme Co.
Oster Manufacturing Co.
Pratt & Whitney Co.
Standard Tool Co.

Threading Opening

Eastern Mch. Screw Corp.
Errington Mechanical Laboratory
Geometric Tool Co.
Hill Acme Co.
Jones & Lamson Mch. Co.
Landis Mch. Co., Inc.
Modern Tool Works
National Acme Co.
Oster Manufacturing Co.

Thread Rolling

Hanson-Whitney Mch. Co.
Pratt & Whitney Co.
Rolled Thread Die Co.

DISCS, Abrasive

Besly, Chas. H., & Co.
Carborundum Co.
Gardner Mch. Co.
Norton Co.
Raybestos-Manhattan, Inc.,
Manhattan-Rubber Div.
Simonds Abrasive Co.
Walls Sales Corp.

DIVIDING HEADS

See Index Centers.

DOWEL PINS

Allen Mfg. Co.
Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
U. S. Tool Co., Inc.

DRAFTING MACHINES

Universal Drafting Machine Co.

DRAWING BOARDS AND TABLES

Universal Drafting Machine Co.

DRESSERS, Grinding Wheel

Carboloy Co., Inc.
Desmond-Stephan Mfg. Co.
Hanchett Mfg. Co.
Ideal Industries, Inc.
Norton Co.
Smit, J. K., & Co.
Standard Tool Co.
Vinco Corporation

DRIFTS, DRILL

Armstrong Bros. Tool Co.
Standard Tool Co.

DRILL HEADS

Unit Type

Barnes Drill Co.
Rehnberg-Jacobson Mfg. Co.

Multiple

Baker Brothers, Inc.
Barnes Drill Co.
Buffalo Forge Co.
Buhr Machine Tool Co.
Delta Mfg. Div., Rockwell Mfg. Co.
Errington Mechanical Laboratory
Ettco Tool Co.
Ex-Cell-O Corp.
Langelier Mfg. Co.
Moline Tool Co.
National Automatic Tool Co.
Thriftmaster Products, Div.,
Thomson Industries, Inc.

DRILL SOCKETS

Armstrong Bros. Tool Co.
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.

Pratt & Whitney Co.
Scully-Jones & Co.
Standard Tool Co.
Union Twist Drill Co.

DRILL SPEEDERS

Graham Mfg. Co., Inc.

DRILL STANDS

Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Union Twist Drill Co.

DRILLING MACHINES

Automatic

Avey Drilling Machine Co.
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F., & John Co.
Bodine Corp.
Bradford Machine Tool Co.
Buhr Machine Tool Co.
Consolidated Mch. Tool Corp.
Cross Co.
Grant Mfg. & Mch. Co.
Kingsbury Mch. Tool Corp.
Langelier Mfg. Co.
National Automatic Tool Co.

Bench

Ames, B. C., Co.
Atlas Press Co.
Avey Drilling Machine Co.
Buffalo Forge Co.
Canedy-Otto Mfg. Co.
Delta Mfg. Div. Rockwell Mfg. Co.
Dumore Co.
Elgin Tool Wks., Inc.
Fosdick Machine Tool Co.
Henry & Wright Mfg. Co.
Langelier Mfg. Co.
Leland-Gifford Co.
Moline Tool Co.
Production Machine Co.
Taylor Mfg. Co.
Walker-Turner Co., Inc.

Boiler

Cincinnati Bickford Tool Co.
Foote-Burt Co.
Sellers, Wm., & Co., Inc.

Gang

Avey Drilling Machine Co.
Baker Brothers, Inc.
Barnes Drill Co.
Bryant Machinery & Engineering Co.
Canedy-Otto Mfg. Co.
Cincinnati Bickford Tool Co.
Consolidated Mch. Tool Corp.
Cross Co.
Delta Mfg. Div. Rockwell Mfg. Co.
Foote-Burt Co.
Fosdick Machine Tool Co.
Ingersoll Milling Mch. Co.
Langelier Mfg. Co.
Leland-Gifford Co.
Moline Tool Co.
National Automatic Tool Co.
Production Machine Co.
Producto Machine Co.
Sellers, Wm., & Co., Inc.

Horizontal Duplex

Avey Drilling Machine Co.
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Bradford Machine Tool Co.
Consolidated Mch. Tool Corp.
Cross Co.
Davis & Thompson Co.
Frew Machine Co.
Kingsbury Mch. Tool Corp.
Langelier Mfg. Co.
National Automatic Tool Co.
Sellers, Wm., & Co., Inc.
Sundstrand Mch. Tool Co.

Inverted

Baker Brothers, Inc.
Barnes Drill Co.

Multiple Center Column Type

Barnes Drill Co.

Multiple Spindle

Avey Drilling Machine Co.
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F., & John, Co.
Baush Machine Tool Co.
Bradford Machine Tool Co.
Bryant Machinery & Engineering Co.
Buffalo Forge Co.
Buhr Machine Tool Co.
Canedy-Otto Mfg. Co.
Cincinnati Bickford Tool Co.
Cross Co.
Delta Mfg. Div. Rockwell Mfg. Co.
Foote-Burt Co.
Fosdick Machine Tool Co.
Greenlee Bros. & Co.
Henry & Wright Mfg. Co.
Ingersoll Milling Mch. Co.
Kingsbury Mch. Tool Corp.
Langelier Mfg. Co.
Leland-Gifford Co.
Moline Tool Co.
National Automatic Tool Co.
Pratt & Whitney Co.
Production Mch. Co.
Sellers, Wm., & Co., Inc.
Taylor & Fenn Co.

Radial

American Tool Wks. Co.
Canedy-Otto Mfg. Co.
Carlton Machine Tool Co.
Cincinnati Bickford Tool Co.

Foote-Burt Co.
Fosdick Machine Tool Co.
Giddings & Lewis Mch. Tool Co.
Sellers, Wm., & Co., Inc.

Rail

See Drilling Machines, Gang.

Sensitive

Atlas Press Co.
Avey Drilling Machine Co.
Buffalo Forge Co.
Canedy-Otto Mfg. Co.
Delta Mfg. Div. Rockwell Mfg. Co.
Foote-Burt Co.
Fosdick Machine Tool Co.
Henry & Wright Mfg. Co.
Langelier Mfg. Co.
Leland-Gifford Co.
Moline Tool Co.
National Automatic Tool Co.
Pratt & Whitney Co.
Production Mch. Co.
Producto Machine Co.
Ryerson, Joseph T., & Son, Inc.
Taylor & Fenn Co.
Taylor Mfg. Co.

Upright

Atlas Press Co.
Avey Drilling Machine Co.
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Bryant Machinery & Engineering Co.
Buffalo Forge Co.
Canedy-Otto Mfg. Co.
Cincinnati Bickford Tool Co.
Consolidated Mch. Tool Corp.
Cross Co.
Davis & Thompson Co.
Delta Mfg. Div. Rockwell Mfg. Co.
Foote-Burt Co.
Fosdick Machine Tool Co.
Ingersoll Milling Mch. Co.
Langelier Mfg. Co.
Leland-Gifford Co.
Moline Tool Co.
National Automatic Tool Co.
Production Mch. Co.
Producto Machine Co.
Rehnberg-Jacobson Mfg. Co.
Rogers Machine Works, Inc.
Ryerson, Joseph T., & Son, Inc.
Sellers, Wm., & Co., Inc.
Taylor Mfg. Co.

Wall Radial

Canedy-Otto Mfg. Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.

DRILLS

Center

Cleveland Twist Drill Co.
Gairing Tool Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Standard Tool Co.
Union Twist Drill Co.
Warner & Swasey Co.

Core

Carboloy Co., Inc.
Ex-Cell-O Corp.
Firth-Sterling Steel Co.
Gairing Tool Co.
Haynes Stellite Co.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Scully-Jones & Co.
Standard Tool Co.
Union Twist Drill Co.

Portable Electric

Dumore Co.
Ryerson, Joseph T., & Son, Inc.

Portable Pneumatic

Ingersoll-Rand Co.
Rotor Tool Co.

Ratchet

Armstrong Bros. Tool Co.
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Standard Tool Co.
Union Twist Drill Co.

Twist

Carboloy Co., Inc.
Cleveland Twist Drill Co.
Firth-Sterling Steel Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Standard Tool Co.
Union Twist Drill Co.

Wire

Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Union Twist Drill Co.

DUPLICATORS

Rockford Machine Tool Co.

DUST CONTROL SYSTEMS

Breuer Electric Mfg. Co.
Pangborn Corp.
Schneible, Claude B., Co.

DYNAMOMETERS
Taylor Mfg. Co.

ELECTRICAL EQUIPMENT
Feedrail Corp.
General Electric Co.
Ideal Industries, Inc.
Richardson-Allen Corp.
Westinghouse Electric Corp.

ELEVATORS
Otis Electric Co.

EMERY WHEELS
See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheel.

ENGRAVING MACHINES
Gorton, George, Mch. Co.

EXTRACTORS, Screw
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.

FACING MACHINE
Ex-Cell-O Corp.

FANS, Exhaust, Electric Ventilating
Buffalo Forge Co.
General Electric Co.

FEEDS FOR PRESSES, Automatic
Cleveland Punch & Shear Works Co.
Peck, Stow & Wilcox Co.
S. & S. Machine Wks.
U. S. Tool Co., Inc.
V & O Press Co.

FILES
Simonds Saw & Steel Co.

Machine
Oliver Instrument Co.

Rotary
Haskins, R. G., Co.
Lewis, B. C., Mfg. Co., Inc.
Lincoln Park Industries, Inc.
Pratt & Whitney Co.
Strand, N. A., & Co.

FILTERS, AIR
United States Electrical Tool Co.

FILTERS, COOLANT AND OIL
Cuno Engineering Corp.
Frantz, S. G., Co., Inc.

FILING MACHINES, Dies, Etc.
Ames, B. C., Co.
DoAll Co.
Grob Brothers
Oliver Instrument Co.

FITTINGS, HYDRAULIC
Hydraulic Press Mfg. Co.
Watson-Stillman Co.

FLEXIBLE COUPLINGS
See Couplings, Flexible.

FLEXIBLE SHAFT EQUIPMENT
Dumore Co.
Haskins, R. G., Co.
Lewis, B. C., Mfg. Co., Inc.
Pratt & Whitney Co.
Strand, N. A., & Co.
Walker-Turner Co., Inc.

FORGINGS (Upsetting) MCHS.
Ajax Manufacturing Co.
Baldwin-Southwark Co.
Hill Acme Co.

FORGINGS

Drop
Bethlehem Steel Co.
Kropp Forge Co.
Williams, J. H., & Co.

Hollow Bored
American Hollow Boring Co.
Bethlehem Steel Co.

Iron and Steel
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Kropp Forge Co.
Morgan Engineering Co.
Steel Improvement & Forge Co.

Manganese, Bronze, Etc.
Cramp Brass & Iron Foundries Div.

Upset
Bethlehem Steel Co.
Kropp Forge Co.
Williams, J. H., & Co.

FORMING AND BENDING MCHS.
Baldwin-Southwark Corp.
Bethlehem Steel Co.
Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Hannifin Mfg. Co.
Hydraulic Press Mfg. Co.
O'Neil Irwin Mfg. Co.
Yoder Co.

FORMING AND STAMPING MCHS.
Cincinnati Shaper Co.
U. S. Tool Co., Inc.

FORMING TOOLS or Tool Blanks
Brown & Sharpe Mfg. Co.
Firth-Sterling Steel Co.
National Broach & Mch. Co.
Pratt & Whitney Co.

FRAMES, Machinery, Welded
Mahon, R. C., Co.

FRICTION MATERIAL
(Brake Lining and Clutch Facing)
Raybestos-Manhattan, Inc.,
Manhattan-Rubber Div.

FURNACES, Equipment for Loading

Hardness
Leeds & Northrup Co.

Heat-Treating
General Electric Co.
Hayes, C. I., Inc.
Leeds & Northrup Co.
Westinghouse Electric Corp.

FURNITURE, Shop
Standard Pressed Steel Co.

GAGE BLOCKS
Johansson Div., Ford Motor Co.
Pratt & Whitney Co.
Scherr, George, Co., Inc.
Van Keuren Co.

GAGES, Comparator
American Measuring Instruments Corp.
Comtor Co.
Federal Products Corp.
Jones & Lamson Machine Co.
Pratt & Whitney Co.
Scherr, George, Co., Inc.
Sheffield Corp.
Woodworth, N. A., Co.

Depth
American Measuring Instruments Corp.
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Scherr, George, Co., Inc.
Standard Gage Co., Inc.
Starrett, L. S., Co.

Dial
American Measuring Instruments Corp.
Ames, B. C., Co.
Bristol Co.
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Starrett, L. S., Co.

Electric
American Measuring Instruments Corp.
Pratt & Whitney Co.

Height
American Measuring Instruments Corp.
Brown & Sharpe Mfg. Co.
Scherr, George, Co., Inc.
Standard Gage Co.
Starrett, L. S., Co.

Plug, Ring and Snap
American Measuring Instruments Corp.
Axelson Mfg. Co.
Brown & Sharpe Mfg. Co.
Carboloy Co., Inc.
Ex-Cell-O Corp.
Federal Products Corp.
Firth-Sterling Steel Co.
Greenfield Tap & Die Corp.
Haynes Stellite Co.
Kennametal, Inc.

Lincoln Park Industries, Inc.
Merz Engineering Co.
Morse Twist Drill & Machine Co.
Pratt & Whitney Co.
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Starrett, L. S., Co.
Stiger Precision Products Co.
Van Keuren Co.
Vinco Corp.
Woodworth, N. A., Co.

Surface

American Measuring Instruments Corp.
Brown & Sharpe Mfg. Co.
Columbus Die, Tool & Mch. Co.
Standard Gage Co., Inc.
Starrett, L. S., Co.

Taper

Brown & Sharpe Mfg. Co.
Johansson Div., Ford Motor Co.
Pratt & Whitney Co.
Sheffield Corp.
Standard Gage Co., Inc.
Starrett, L. S., Co.
Vinco Corporation

Thread

American Measuring Instruments Corp.
Axelson Mfg. Co.
Bath, John, & Co., Inc.
Brown & Sharpe Mfg. Co.
Detroit Tap & Tool Co.
Federal Products Corp.
Greenfield Tap & Die Corp.
Hanson-Whitney Machine Co.
Jones & Lamson Machine Co.
Lincoln Park Industries, Inc.
Merz Engineering Co.
Pratt & Whitney Co.
Sheffield Corp.
Starrett, L. S., Co.
Vinco Corporation
Woodworth, N. A., Co.

GASKETS

Garlock Packing Co.
Raybestos-Manhattan, Inc., Manhattan-Rubber Div.

GEAR BLANKS, Non-Metallic

Braun Gear Co.
Ganschow Gear Co.
General Electric Co.
Westinghouse Electric Corp.

GEAR BURNISHING MACHINES

Fellows Gear Shaper Co.

GEAR CHECKING INSTRUMENTS AND EQUIPMENT

Brown & Sharpe Mfg. Co.
Fellows Gear Shaper Co.
Gleason Works
Michigan Tool Co.
National Broach & Mch. Co.
Pratt & Whitney Co.
Scherr, George, Co., Inc.
Vinco Corporation

GEAR CUTTING MACHINES, Bevel (Generator)

Bilgram Gear & Machine Wks.
Gleason Works

(Rotary Cutter)

Newark Gear Cutting Machine Co.
Producto Machine Co.
Waltham Mch. Wks.

GEAR CUTTING MACHINES, Helical and Spur (Hub)

Barber-Colman Co.
Farrel-Birmingham Co., Inc. (Shaper or Planer Type)
Fellows Gear Shaper Co.
National Tool Co.
Newark Gear Cutting Machine Co.
New Jersey Gear & Mfg. Co.
Triplex Machine Tool Corp.

Shear-speed Type

Michigan Tool Co.

GEAR CUTTING MACHINES, Spiral-Bevel

Gleason Works

GEAR CUTTING MACHINES, Worm and Worm Wheels

Barber-Colman Co.
Fellows Gear Shaper Co. (Straight and Hourglass Type)
New Jersey Gear & Mfg. Co.
Producto Machine Co.

GEAR FINISHING MACHINES

Fellows Gear Shaper Co.
Michigan Tool Co.

GEAR GRINDING MACHINES

Fitchburg Grinding Mch. Corp.
Gleason Works
Pratt & Whitney Co.
Vinco Corporation

GEAR HARDENING MACHINES

Fellows Gear Shaper Co.
Gleason Works

GEAR LAPPING MACHINES

Fellows Gear Shaper Co.
Gleason Works
Michigan Tool Co.
National Broach & Mch. Co.

GEAR MOTORS

See Speed Reducers.

GEAR SHAVING MACHINES

Fellows Gear Shaper Co.
National Broach & Mch. Co.

GEAR TESTING MACHINERY
Baldwin-Southwark Corp.
Brown & Sharpe Mfg. Co.
Farrel-Birmingham Co., Inc.
Fellows Gear Shaper Co.
National Tool Co.
Newark Gear Cutting Machine Co.
Pratt & Whitney Co.
Scherr, George, Co., Inc.
Vinco Corp.

GEAR TOOTH GRINDING REST
Utility Tool & Mfg. Co.

GEARS

Cut
Atlantic Gear Works, Inc.
Automotive Gear Works, Inc.
Baush Machine Tool Co.
Beaver Gear Works, Inc.
Bethlehem Steel Co.
Bilgram Gear & Machine Works
Boston Gear Works, Inc.
Braun Gear Co.
Cincinnati Gear Co.
Cleveland Worm & Gear Co.
Cone Drive Div., Michigan Tool Co.
DeLaval Steam Turbine Co.
Detroit Bevel Gear Co.
Diefendorf Gear Corp.
Earle Gear & Mch. Co.
Eberhardt-Denver Co.
Fairfield Mfg. Co.
Farrel-Birmingham Co., Inc.
Fellows Gear Shaper Co.
Foote Bros. Gear & Machine Corp.
Ganschow Gear Co.
Gear Specialties
General Electric Co.
Gleason Works
Grant Gear Wks., Inc.
Hartford Special Mchy. Co.
James, D. O., Mfg. Co.
Massachusetts Gear & Tool Co.
Meisel Press Mfg. Co.
Michigan Tool Co.
Newark Gear Cutting Machine Co.
New Jersey Gear & Mfg. Co.
Ohio Gear Co.
Perkins Mch. & Gear Co.
Philadelphia Gear Works
Pittsburgh Gear & Machine Co.
Sier-Bath Gear Co., Inc.
Stahl Gear & Machine Co.
Taylor Mch. Co.
Technical Products Co.
Westinghouse Electric Corp.

Molded
Foote Bros. Gear & Machine Corp.
Philadelphia Gear Works
Westinghouse Electric Corp.

Rawhide and Non-Metallic
Atlantic Gear Works, Inc.
Boston Gear Works, Inc.
Braun Gear Co.
Cincinnati Gear Co.
Diefendorf Gear Corp.
Earle Gear & Mch. Co.
Foote Bros. Gear & Machine Corp.
Ganschow Gear Co.
General Electric Co.
Grant Gear Works, Inc.
Hartford Special Mchy. Co.
James, D. O., Mfg. Co.
Massachusetts Gear & Tool Co.
Meisel Press Mfg. Co.
Philadelphia Gear Works
Pittsburgh Gear & Machine Co.
Stahl Gear & Machine Co.
Taylor Mch. Co.
Westinghouse Electric Corp.

GENERATORS, ELECTRIC
General Electric Co.
Lincoln Electric Co.
Master Electric Co.
Reliance Electric & Mfg. Co.
Westinghouse Electric Corp.

GOGGLES
American Optical Co.

GRADUATING MACHINES
Gorton, George, Mch. Co.
Noble & Westbrook Mfg. Co.

GREASE
Cities Service Oil Co.
Gulf Oil Corp.
Shell Oil Co., Inc.
Standard Oil Co. (Indiana)
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

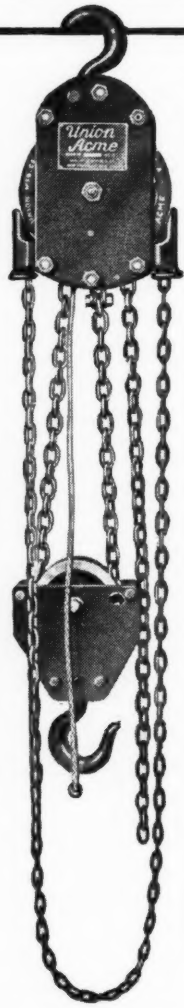
GRINDERS

Carbide Tool
Oliver Instrument Co.
Sundstrand Mch. Tool Co.

Die and Mold
Consolidated Mch. Tool Corp.
Dumore Co.
Haskins, R. G., Co.
Pratt & Whitney Co.

Oilstone, for Wooworking Tools
Mummert-Dixon Co.

Pneumatic
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.
Madison-Kipp Corp.
Rotor Tool Co.



Portable Electric and Toolpost

Dumore Co.
Haskins, R. G., Co.

GRINDING MACHINES

Abrasive Belt

Delta Mfg. Div. Rockwell Mfg. Co.
DoAll Co.
Hill Acme Co.
Mattison Mch. Wks.
Porter-Cable Machine Co.
Production Machine Co.
Walker-Turner Co., Inc.
Walls Sales Corp.

Bench

Atlas Press Co.
Crystal Lake Grinders
Delta Mfg. Div. Rockwell Mfg. Co.
Hardinge Brothers, Inc.
Rivett Lathe & Grinder, Inc.
Ryerson, Joseph T., & Son, Inc.
Walker-Turner Co., Inc.

Broach

Gear Grinding Machine Co.

Camshaft

Landis Tool Co.
Norton Co.

Carbide Tool

Carboloy Co., Inc.
Ex-Cell-O Corp.
Oliver Instrument Co.

Centerless

Cincinnati Grinders, Inc.
Heald Machine Co.
Landis Tool Co.
Triplex Machine Tool Corp.

Chaser or Die

Eastern Mch. Screw Corp.
Fitchburg Grinding Mch. Corp.
Geometric Tool Co.
Landis Machine Co., Inc.

Chucking

Bryant Chucking Grinder Co.
Fitchburg Grinding Mch. Corp.

Crankshaft

Landis Tool Co.
Norton Co.

Cylinder

Bryant Chucking Grinder Co.
Heald Machine Co.
Landis Tool Co.

Cylindrical

Arter Grinding Machine Co.
Brown & Sharpe Mfg. Co.
Cincinnati Grinders, Inc.
Crystal Lake Grinders
Fitchburg Grinding Mch. Corp.
Landis Tool Co.
Modern Tool Wks.
(Cons. Mch. Tool Corp.)
Morse Twist Drill & Mch. Co.
Norton Co.
Pratt & Whitney Co.
Rivett Lathe & Grinder, Inc.
Thompson Grinder Co.
Triplex Machine Tool Corp.

Disc

Besly, Chas. H., & Co.
Gardner Machine Co.
Hanchett Mfg. Co.
Porter-Cable Machine Co.
Production Mch. Co.

Drill

Delta Mfg. Div. Rockwell Mfg. Co.
Gallmeyer & Livingston Co.
Oliver Instrument Co.
Sellers, Wm., & Co., Inc.
Union Twist Drill Co.

Face

Abrasive Mch. Tool Co.
Hanchett Mfg. Co.
Oliver Instrument Co.

Flexible Shaft

See Flexible Shaft Equipment.

Gear Tooth

Gear Grinding Machine Co.
National Tool Co.
Pratt & Whitney Co.

For Sharpening Turning and Planing Tools

Delta Mfg. Div. Rockwell Mfg. Co.
Oliver Instrument Co.
Production Mch. Co.
Sellers, Wm., & So., Inc.
Walker, O. S., Co., Inc.
Waltham Mch. Wks.

Internal

Bryant Chucking Grinder Co.
Heald Machine Co.
Landis Tool Co.
Modern Tool Wks.
(Cons. Mch. Tool Corp.)
Rivett Lathe & Grinder, Inc.

Jig

Moore Special Tool Co., Inc.

Knife and Shear Blade

Bridgeport Safety Emery Wheel Co., Inc.
Hill Acme Co.

HOSE, Leather, Rubber, Metallic, Etc.
American Metal Hose Div., American Brass Co.
Cleveland Pneumatic Tool Co.
Raybestos-Manhattan, Inc. Manhattan-Rubber Div.

HYDRAULIC MACHINERY, Tools and Equipment
Baldwin-Southwark Corp.
Barnes, John S., Corp.
Bethlehem Steel Co.
Birdsboro Steel Fdry. & Mch. Co.
Bliss, E. W., Co.
Chambersburg Engineering Co.
Cross Co.
Denison Engineering Co.
Elmes Engineering Works
Farquhar, A. B., Co.
Hannifin Mfg. Co.
Hydraulic Press Mfg. Co.
Hydropress Co., Inc.
Lake Erie Engineering Corp.
Oilgear Co.
Rockford Machine Tool Co.
Sundstrand Mch. Tool Co.
Watson-Stillman Co.

HYDRAULIC POWER UNITS OR TOOL HEADS
Anker-Holth Mfg. Co.
Barnes Drill Co.
Barnes, John S., Corp.
Barnes, W. F. and John, Co.
Ex-Cell-O Corp.
Hannifin Mfg. Co.
Hydraulic Machinery, Inc.
National Automatic Tool Co.

HYDRAULIC, Tool Head or Power Unit
Barnes Drill Co.
National Automatic Tool Co.
New Britain-Gridley Mch. Div. New Britain Machine Co.

INDEX CENTERS
Abrasive Mch. Tool Co.
Brown & Sharpe Mfg. Co.
Kempsmith Mch. Co.
Vinco Corporation

INDEXING and Spacing Fixtures
Grinders & Fixtures, Inc.
Hartford Special Mchry. Co.
Vinco Corporation

INDICATOR, Dial
American Measuring Instrument Corp.
Ames, B. C., Co.
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Standard Gage Co., Inc.
Starrett, L. S., Co.

Speed
Bristol Co.
Brown & Sharpe Mfg. Co.
Starrett, L. S., Co.
Veeder-Root, Inc.

Test
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Standard Gage Co., Inc.
Starrett, L. S., Co.

INDUCTION HEATING EQUIPMENT
Lepel High Frequency Laboratories, Inc.
Ohio Crankshaft Co.

INGOTS, Manganese, Bronze and Brass
Cramp Brass & Iron Foundries Div.

INTENSIFIERS, Hydraulic
Baldwin-Southwark Corp.
Elmes Engineering Works
Farquhar, A. B., Co.
Hydraulic Press Mfg. Co.
Morgan Engineering Co.
Watson-Stillman Co.

JACKS, Planer
Armstrong Bros. Tool Co.

JIG BORER
See Boring Machines, Jig.

JIGS AND FIXTURES
American Measuring Instruments Corp.
American Type Foundries, Inc.
Columbus Die, Tool & Mch. Co.
Ex-Cell-O Corp.
Hartford Special Mchry. Co.
Ingersoll Milling Mch. Co.
Merz Engineering Co.
Sundstrand Mch. Tool Co.
Vinco Corporation

KEYSEATERS
Baker Bros., Inc.
Consolidated Mch. Tool Corp.
Davis Keyseater Co.
Lapointe Machine Tool Co.

KNURL HOLDERS
Brown & Sharpe Mfg. Co.
Graham Mfg. Co., Inc.
Pratt & Whitney Co.

KNURLING TOOLS
Armstrong Bros. Tool Co.
Fakes, Joseph B., & Co.
Graham Mfg. Co., Inc.
Pratt & Whitney Co.
Williams, J. H., & Co.

LAPPING MACHINES
Cincinnati Grinders, Inc.
Ex-Cell-O Corp.
Fellows Gear Shaper Co.
Norton Co.
Sommer & Adams Co.
Spitfire Tools, Inc.

LATHE ATTACHMENTS
American Tool Wks. Co.
Atlas Press Co.
Bradford Machine Tool Co.
Gisholt Mch. Co.
Hendey Machine Co.
Jones & Lamson Mch. Co.
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Mch. Tool Co.
McCrosky Tool Corp.
Monarch Mch. Tool Co.
Newton Mfg. Co.
Pratt & Whitney Co.
Reed-Prentice Corp.
Rivett Lathe & Grinder, Inc.
Seneca Falls Mch. Co.
South Bend Lathe Wks., Inc.
Springfield Mch. Tool Co.
Stark Tool Co.
Sundstrand Mch. Tool Co.
Warner & Swasey Co.

LATHE AND GRINDING DOGS
Armstrong Bros. Tool Co.
Williams, J. H., & Co.

LATHES

Automatic
Baird Machine Co.
Cross Co.
Gisholt Mch. Co.
Goss & DeLeeuw Mch. Co.
Jones & Lamson Mch. Co.
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Mch. Tool Co.
Monarch Mch. Tool Co.
National Acme Co.
New Britain-Gridley Mch. Div., New Britain Machine Co.
Porter-Cable Machine Co.
Potter & Johnston Mch. Co.
Pratt & Whitney Co.
Reed-Prentice Corp.
Seneca Falls Mch. Co.
Sundstrand Mch. Tool Co.
Wickes Bros.

Axles and Shaft
Consolidated Mch. Tool Corp.
Cross Co.
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Mch. Tool Co.
Sellers, Wm., & Co., Inc.
Seneca Falls Mch. Co.
Sundstrand Mch. Tool Co.

Bench
Ames, B. C., Co.
Ames Precision Mch. Wks.
Atlas Press Co.
Elgin Tool Wks., Inc.
Hardinge Brothers, Inc.
LeBlond, R. K., Mch. Tool Co.
Pratt & Whitney Co.
Rivett Lathe & Grinder, Inc.
Seneca Falls Mch. Co.
Sheldon Mch. Co.
South Bend Lathe Wks.
Stark Tool Co.

Boring
Gisholt Mch. Co.
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Mch. Tool Co.
Wickes Bros.

Brass Workers'
Acme Machine Tool Co.
Bardons & Oliver, Inc.
Gisholt Mch. Co.
Seneca Falls Mch. Co.
Springfield Mch. Tool Co.
Warner & Swasey Co.

Crankshaft
Consolidated Mch. Tool Corp.
Cross Co.
LeBlond, R. K., Mch. Tool Co.
Sundstrand Mch. Tool Co.
Wickes Bros.

Double-End
Consolidated Mch. Tool Corp.
LeBlond, R. K., Mch. Tool Co.
Sundstrand Mch. Tool Co.
Wickes Bros.

Engine and Toolroom
Acme Machine Tool Co.
American Tool Wks. Co.
Atlas Press Co.
Axelson Manufacturing Co.
Bradford Machine Tool Co.
Consolidated Mch. Tool Corp.
Hendey Machine Co.
LeBlond, R. K., Mch. Tool Co.
Lehmann Machine Co.
Lodge & Shipley Mch. Tool Co.
Logan Engineering Co.
Mackintosh & Hemphill Co.
Monarch Mch. Tool Co.
Morey Machinery Co., Inc.
Pratt & Whitney Co.
Reed-Prentice Corp.
Rivett Lathe & Grinder, Inc.
Seneca Falls Mch. Co.
Sheldon Mch. Co.
Sidney Machine Tool Co.
Simmons Machine Tool Corp.
South Bend Lathe Wks.
Springfield Mch. Tool Co.
Wickes Bros.

Extension Bed and Gap
Gisholt Mch. Co.
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Mch. Tool Co.
Seneca Falls Mch. Co.
South Bend Lathe Wks.
Warner & Swasey Co.

Gun
Consolidated Mch. Tool Corp.
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Mch. Tool Co.
Seneca Falls Mch. Co.
Springfield Mch. Tool Co.
Wickes Bros.

Manufacturing Type
Lipe-Rollway Corporation
Lodge & Shipley Mch. Tool Co.

Spinning
See Chucking Machines.

Toolroom
See Lathes, Engine and Toolroom.

Turret
Acme Machine Tool Co.
Bardons & Oliver, Inc.
Brown & Sharpe Mfg. Co.
Bullard Company
Foster Div., International Detrola Corp.
Gisholt Mch. Co.
Hardinge Brothers, Inc. (Bench or Cabinet Mounting)
Jones & Lamson Mch. Co.
LeBlond, R. K., Mch. Tool Co.
Morey Machinery Co.
National Acme Co.
Oster Mfg. Co.
Potter & Johnston Mch. Co.
Production Machine Co.
Rivett Lathe & Grinder, Inc.
Simmons Machine Tool Corp.
South Bend Lathe Wks., Inc.
Springfield Mch. Tool Co.
Stark Tool Co.
Stearns-Roger Mfg. Co.
Warner & Swasey Co.

Turret Automatic
Potter & Johnston Mch. Co.

Vertical Turret
Bullard Company
Rogers Machine Works, Inc.

LEVELS
Pratt & Whitney Co.
Starrett, L. S., Co.
Universal Boring Mch. Co.

LUBRICANTS, Including Extreme Pressure (EP) Machinery Lubricants
Cities Service Oil Co.
Gulf Oil Corp.
Shell Oil Co., Inc.
Sinclair Refining Co.
Socony Vacuum Oil Co., Inc.
Standard Oil Co. (Indiana)
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

LUBRICATING SYSTEMS
Madison-Kipp Corp.
Manzel Brothers Co.
Rivett Lathe & Grinder, Inc.

MACHINISTS' SMALL TOOLS
See Calipers, Hammers, Wrenches, Drills, Taps, Etc.

MANDRELS
See Arbors and Mandrels.

MARKING MACHINES AND DEVICES
Colonial Broach Co.
Ideal Industries, Inc.
Noble & Westbrook Mfg. Co.
Sossner, Inc.

MEASURING MACHINES AND INSTRUMENTS, PRECISION
American Measuring Instruments Corp.
Federal Products Corp.
Hanson-Whitney Mch. Co.
Norma-Hoffmann Bearings Corp.
Pratt & Whitney Co.
Scherr, George, Co., Inc.
Van Keuren Co.
Vinco Corporation

MEASURING WIRES, Thread, Spline and Gear
American Measuring Instruments Corp.
Van Keuren Co.

METAL DISINTEGRATOR
Elox Corp.

METALS, Bearing
See Bearings, Bronze, Babbitt, Etc. and Bushings, Brass, Bronze, Etc.

METALS, Perforated
Chicago Perforating Co.

METERS
See Recording Instruments.

MICROMETERS
Bath, John, & Co., Inc.
Brown & Sharpe Mfg. Co.
Davis & Thompson Co.
Pratt & Whitney Co.
Scherr, George, Co., Inc.
Starrett, L. S., Co.
Van Keuren Co.

MICROSCOPES, Toolmakers
Bausch & Lomb Optical Co.
Scherr, George, Co., Inc.

MILLING ATTACHMENTS
Brown & Sharpe Mfg. Co.
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Elgin Tool Wks., Inc.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Kempsmith Mch. Co.
Porter-Cable Machine Co.
Reed-Prentice Corp.
Rivett Lathe & Grinder, Inc.
Sundstrand Mch. Tool Co.
Van Norman Co.

MILLING MACHINES

Automatic
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Cross Co.
Ingersoll Milling Mch. Co.
Jones & Lamson Mch. Co.
Kearney & Trecker Corp.
Sundstrand Mch. Tool Co.
U. S. Tool Company, Inc.

Bench
Ames, B. C., Co.
Atlas Press Co.
Burke Machine Tool Co.
Hardinge Brothers, Inc. (Bench or Pedestal Type)
Pratt & Whitney Tool Co.
Stark Tool Co.

Circular Continuous
Consolidated Mch. Tool Corp.
Cross Co.
Davis & Thompson Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Sundstrand Mch. Tool Co.

Die Sinking
See Die Sinking Machines.

Duplex
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Cross Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Taylor & Fenn Co.

Hand
Burke Machine Tool Co.
Frew Machine Co.
Nichols, W. H., & Sons
Sundstrand Mch. Tool Co.
Van Norman Co.

Horizontal, Plain and Universal
Brown & Sharpe Mfg. Co.
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Cross Co.
DoAll Co.
Frew Machine Co.
Gorton, George, Mch. Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Kempsmith Mch. Co.
Machinery Mfg. Co.
Ohio Machine Tool Co.
Producto Machine Co.
Sidney Machine Tool Co.
Simmons Machine Tool Corp.
Sundstrand Mch. Tool Co.
Van Norman Mch. Tool Co.

Lincoln Type
Brown & Sharpe Mfg. Co.
Sundstrand Mch. Tool Co.

Planer Type
Cincinnati Planer Co.
Consolidated Mch. Tool Corp.
Davis & Thompson Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Sellers, Wm., & Co., Inc.
Stokerunit Corp.

Planetary
Cross Gear & Machinery Co.

Ram Type, Universal
Van Norman Co.

Vertical
Brown & Sharpe Mfg. Co.
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Cross Co.
DoAll Co.
Gorton, George, Mch. Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Machinery Mfg. Co.
Pratt & Whitney Co.
Reed-Prentice Corp.
Sidney Machine Tool Co.
Sommer & Adams Co.
Sundstrand Mch. Tool Co.
Taylor & Fenn Co.

MODEL AND EXPERIMENTAL WORK
See Special Machinery Tools.

MOLD AND DIE COPYING MACHINES

Gorton, George, Mch. Co.

MOLDING MACHINES, Plastic Products

Hydraulic Press Mfg. Co.
Reed-Prentice Corp.
Watson-Stillman Co.

MOLYBDENUM

Climax Molybdenum

MOTORS, Electric

Dumore Co.
General Electric Co.
Lincoln Electric Co.
Master Electric Co.
Reliance Electric & Engrg. Co.
Star Electric Motor Co.
Westinghouse Electric Corp.

MOUNTINGS, RUBBER, JOINTS AND COUPLINGS

Lord Manufacturing Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

MULTIPLE-SLIDE FORMING MACHINES

Baird Machine Co.
U. S. Tool Co., Inc.

NAME PLATES

Noble & Westbrook Mfg. Co.

NIBBLING MACHINES

Campbell, Andrew C., Div., American Chain & Cable Co., Inc.
Gray Machine Co.

Nickel

International Nickel Co.

NIPPLE THREADING MACHINERY

Landis Mch. Co., Inc.
Oster Manufacturing Co.

NUMBERING MACHINES

Noble & Westbrook Mfg. Co.

NUT SETTING EQUIPMENT

See Screw Driving and Nut Setting Equipment.

NUT TAPPERS

See Bolt and Nut Machinery.

NUTS, Cold Forged, Wing and Cap

Parker-Kalon Corp.
Republic Steel Corp. (Union Drawn Steel Div.)

NUTS, Self-Locking

Elastic Stop Nut Corp. of America

NUTS, Thumb or Wing and Cap

Republic Steel Corp. (Union Drawn Steel Div.)
Williams, J. H., & Co.

OIL CAPS

Besly, Chas. H., & Co.
Gits Bros. Mfg. Co.
Trico Fuse Mfg. Co.

OIL EXTRACTORS

DeLaval Separator Co.

OIL GROOVERS

Hanson-Whitney Mch. Co.

OIL HOLE COVERS

Gits Bros. Mfg. Co.

OILERS AND LUBRICATORS

Gits Bros. Mfg. Co.
Madison-Kipp Corp.
Manzel Brothers Co.
Trico Fuse Mfg. Co.

OILS, Cutting

Cimcool Div., Cincinnati Milling Machine Co.
Cities Service Oil Co.
Gulf Oil Corp.
Shell Oil Co., Inc.
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

Lubricating

Besly, Chas. H., & Co.
Cities Service Oil Co.
Gulf Oil Corp.
Shell Oil Co., Inc.
Sinclair Refining Co.
Socony Vacuum Oil Co. Inc.
Standard Oil Co. (Indiana)
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

Quenching and Tempering

Cities Service Oil Co.
Gulf Oil Corp.
Shell Oil Co., Inc.
Standard Oil Co. (Indiana)
Stuart, D. A., Oil Co., Ltd.

Soluble

See Compounds, Cutting, Grinding, Metal Drawings, Etc.

ORDNANCE MACHINES, Special

Rehnberg-Jacobson Mfg. Co.

PACKING, Leather, Metal, Rubber, Asbestos, Etc.

Garlock Packing Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.
Watson-Stillman Co.

PARALLELS

Brown & Sharpe Mfg. Co.
Johansson Div., Ford Motor Co.
Starrett, L. S., Co.
Taft-Peirce Mfg. Co.
Walker, O. S., Co., Inc.

PATTERNS, WOOD

Mummert-Dixon Co.

PHOSPHOR BRONZE—See Bronze.

PILLOW BLOCKS

Norma-Hoffmann Bearings Corp.
S K F Industries, Inc.
Standard Pressed Steel Co.

PIPE, BRASS AND COPPER

American Brass Co.

PIPE CUTTING AND THREADING MACHINES

Foote-Burt Co.
Landis Mch. Co., Inc.
Oster Manufacturing Co.

PIPE JOINTS, SWIVEL

Chicksan Co.

PIPE, STEEL

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
National Tube Co. (U. S. Steel Corp. Div.)
Republic Steel Corp. (Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.

PIPE TONGS

Williams, J. H., & Co.

PISTON PINS

Bell Engineering Co.

PLANER ATTACHMENTS

Cincinnati Planer Co.
Consolidated Mch. Tool Co.
Hanson-Whitney Mch. Co.
Rockford Machine Tool Co.

PLANERS

Baldwin-Southwark Corp.
Cincinnati Planer Co.
Consolidated Mch. Tool Corp. (Incl. Plate, Rotary and Crank Types)
Ohio Machine Tool Co.
Rockford Machine Tool Co.
Sellers, Wm., & Co., Inc.

Openside

Cincinnati Planer Co.
Rockford Machine Tool Co.

PLASTICS and Plastic Products

Bakelite Corp.

PLATE ROLLS

Baldwin-Southwark Corp.
Bethlehem Steel Co.
Cleveland Punch & Shear Wks. Co.
Consolidated Mch. Tool Corp.
Hannifin Mfg. Co.
Ryerson, Joseph T., & Son, Inc.

PLATES, Surface

Brown & Sharpe Mfg. Co.
Ideal Industries, Inc.
Jones Machine Tool Wks., Inc.
Rotor Tool Co.
Scherr, George, Co., Inc.
Taft-Peirce Mfg. Co.
U. S. Tool Company, Inc.
Vinco Corporation

PNEUMATIC EQUIPMENT

Anker-Holth Mfg. Co.
Bliss, E. W., Co.
Hanna Engineering Works
Hannifin Mfg. Co.
Ingersoll-Rand Co.
Valvair Corp.

POLISHING LATHES and Machines

Besly, Chas. H., & Co.
Bridgeport Safety Emery Wheel Co., Inc.
DoAll Co.
Gardner Machine Co.
Production Mch. Co.
Sundstrand Mch. Tool Co.

POLISHING TOOLS, Portable

Stow Mfg. Co.
Strand, N. A., & Co.

PRESSES

Arbor

Baldwin-Southwark Corp.
Canedy-Otto Mfg. Co.
Dake Engine Co.
Elmes Engineering Works
Famco Machine Co.
Farquhar, A. B., Co.
General Manufacturing Co.
Hannifin Mfg. Co.
Lempco Products, Inc.
Sheldon Mch. Co.
Watson-Stillman Co.
Wilson, K. R.

Broaching

American Broach & Mch. Co.
Bliss, E. W., Co.
General Manufacturing Co.
Lapointe Machine Tool Co.
Oilgear Co.
Peck, Stow & Wilcox Co.
V & O Press Co.
Watson-Stillman Co.

Extrusion

Hydraulic Press Mfg. Co.
Hydropress Co., Inc.
Lake Erie Engineering Corp.
Watson-Stillman Co.

Foot

Baird Machine Co.
Bliss, E. W., Co.
Etna Machine Co.
Famco Machine Co.
Niagara Machine & Tool Wks.
Peck, Stow & Wilcox Co.
Taylor & Fenn Co.
V & O Press Co.

Forging

Ajax Manufacturing Co.
Baldwin-Southwark Corp.
Bethlehem Steel Co.
Bliss, E. W., Co.
Clearing Mch. Co.
Cleveland Punch & Shear Works Co.
Erie Foundry Co.
Farquhar, A. B., Co.
Henry & Wright Mfg. Co.
Hydraulic Press Mfg. Co.
Hydropress Co., Inc.
Lake Erie Engineering Corp.
Morgan Engineering Co.
Niagara Machine & Tool Wks.
Peck, Stow & Wilcox Co.
Verson Allsteel Press Co.
V & O Press Co.
Watson-Stillman Co.
Zeh & Hahnemann Co.

Hydraulic

American Broach & Mch. Co.
Baldwin-Southwark Corp.
Bethlehem Steel Co.
Birdsboro Steel Fdry. & Mch. Co.
Bliss, E. W., Co.
Clearing Mch. Co.
Colonial Broach Co.
Dake Engine Co.
Denison Engineering Co.
Elmes Engineering Co.
Erie Foundry Co.
Farrel-Birmingham Co., Inc.
Farquhar, A. B., Co.
Hannifin Mfg. Co.
Hydraulic Press Mfg. Co.
Hydropress Co., Inc.
Lake Erie Engineering Co.
Lapointe Machine Tool Co.
Morgan Engineering Co.
Oilgear Co.
Verson Allsteel Press Co.
Warren City Mfg. Co.
Watson-Stillman Co.
Wilson, K. R.

Percussion

Wilson, K. R.

Screw

Bliss, E. W., Co.
General Manufacturing Co.
Niagara Machine & Tool Wks.
Zeh & Hahnemann Co.

Sheet Metal Working

Baldwin-Southwark Corp.
Bliss, E. W., Co.
Cincinnati Shaper Co.
Clearing Mch. Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. & Tool Corp.
Famco Machine Co.
Farquhar, A. B., Co.
Henry & Wright Mfg. Co.
Hydraulic Press Mfg. Co.
L & J Press Corp.
Lake Erie Engineering Corp.
Niagara Machine & Tool Wks.
Peck, Stow & Wilcox Co.
Quickwork-Whiting Div. of Whiting Corp.
Steelweld Mchry. Div. of Cleveland Crane & Engrg. Co.
Verson Allsteel Press Co.
V & O Press Co.
Warren City Mfg. Co.
Watson-Stillman Co.
Zeh & Hahnemann Co.

Straightening

Baldwin-Southwark Corp.
Canedy-Otto Mfg. Co.
Colonial Broach Co.
Consolidated Mch. Tool Corp.
Elmes Engineering Works
Farquhar, A. B., Co.
General Manufacturing Co.
Hannifin Mfg. Co.
Hydraulic Press Mfg. Co.
Jones Machine Tool Wks., Inc.
Lempco Products, Inc.
Morgan Engineering Co.
Oilgear Co.
Springfield Mch. Tool Co.
Watson-Stillman Co.

PRINT PAPER, BLUE, WHITE, ETC.

Ozalid Products Div. General Aniline & Film Corp.

PROFILING MACHINES

Consolidated Mch. Tool Corp.
Frew Machine Co.
Gorton, George, Mch. Co.
Leland-Gifford Co.
Morey Machinery Co., Inc.
Pratt & Whitney Co.
Reed-Prentice Corp.

PULLEYS

Boston Gear Works, Inc.
DoAll Co.
Foote Bros. Gear & Machine Corp.
Hill Acme Co.
Sellers, Wm., & Co., Inc.

Friction Clutch

Brown & Sharpe Mfg. Co.

PUMPS, Coolant, Lubricant and Oil

Brown & Sharpe Mfg. Co.
DeLaval Steam Turbine Co.
Ingersoll-Rand Co.
Ruthman Machinery Co.
Tuthill Pump Co.
Viking Pump Co.

Hydraulic

Baldwin-Southwark Corp.
Barnes, John S., Corp.
Bethlehem Steel Co.
Brown & Sharpe Mfg. Co.
DeLaval Steam Turbine Co.
Elmes Engineering Works
Hydropress Co., Inc.
Ingersoll-Rand Co.
Lapointe Machine Tool Co.
McIntyre Co.
Oilgear Co.
Sundstrand Mch. Tool Co.
Tuthill Pump Co.
Viking Pump Co.
Watson-Stillman Co.

Pneumatic

Ingersoll-Rand Co.

Rotary

Brown & Sharpe Mfg. Co.
DeLaval Steam Turbine Co.
Tuthill Pump Co.
Viking Pump Co.

PUNCHES AND DIES

See Dies, Sheet Metal, etc.

PUNCHES, CENTERING

Cleveland Punch & Shear Works Co.

PUNCHING MACHINERY

Buffalo Forge Co.
Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Hannifin Mfg. Co.
Niagara Machine & Tool Wks.
Peck, Stow & Wilcox Co.
Ryerson, Joseph T., & Son, Inc.
Steelweld Mchry. Div. of Cleveland Crane & Engrg. Co.
Watson-Stillman Co.

PUNCHING AND RIVETING MACHINES

Hannifin Mfg. Co.

PRYROMETERS

Bristol Co.
Leeds & Northrup Co.
Shore Instrument & Mfg. Co.

RACK CUTTING MACHINES AND ATTACHMENTS

Gould & Eberhardt

RACKS, GEAR, CUT

Atlantic Gear Works, Inc.
Boston Gear Works, Inc.
Brown & Sharpe Mfg. Co.
Fellows Gear Shaper Co.
Foote Bros. Gear & Machine Corp.

Hartford Special Mchry. Co.
James, D. O., Mfg. Co.
Massachusetts Gear & Tool Co.
Meisel Press Mfg. Co.
Philadelphia Gear Works
Stahl Gear & Machine Co.

REAMER HOLDERS

Gairing Tool Co.
Gisholt Machine Co.
Landis Mch. Co., Inc.
Lipe-Rollway Corporation
McCrosky Tool Corp.
Scully-Jones & Co.
Warner & Swasey Co.

REAMERS

Barber-Colman Co.
Butterfield Div., Union Twist Drill Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Columbus Die, Tool & Mch. Co.
Ex-Cell-O Corporation
Firth-Sterling Steel Co.
Gairing Tool Co.
Gammons-Hoaglund Co.
Genesee Tool Co.
Gisholt Machine Co.
Greenfield Tap & Die Corp.
Haynes Stellite Co.
Lipe-Rollway Corporation
McCrosky Tool Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Scully-Jones & Co.
Standard Tool Co.
Tungsten Carbide Tool Co.
Union Twist Drill Co.

Adjustable

Barber-Colman Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Ex-Cell-O Corporation
Firth Sterling Steel Co.
Gairing Tool Co.
Gisholt Machine Co.
Greenfield Tap & Die Corp.
McCrosky Tool Corp.
Morse Twist Drill & Mch. Co.
Pratt & Whitney Co.
Rogers, John M., Tool Corp.
Standard Tool Co.
Taft-Peirce Mfg. Co.
Union Twist Drill Co.

Taper Pin

Butterfield Div., Union Twist Drill Co.
Gammons-Hoaglund Co.
Greenfield Tap & Die Corp.
Lipe-Rollway Corporation
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Standard Tool Co.
Union Twist Drill Co.

REAMING MACHINES

Van Norman Co.

RECORDING INSTRUMENTS

For Counting

National Acme Co.

For Electricity

Bristol Co.
General Electric Co.
Leeds & Northrup Co.

For Pressure

Bristol Co.
Leeds & Northrup Co.

For Speed

Bristol Co.
Leeds & Northrup Co.

For Temperature

Bristol Co.
Leeds & Northrup Co.

REELS, Stock, Standard and Automatic

S & S Mch. Wks.
U. S. Tool Company, Inc.

REFRACTORIES, Heat Treating Furnace

Norton Co.

REGULATORS, Temperature

Bristol Co.
General Electric Co.
Leeds & Northrup Co.

REMOVERS, Japan, Enamel, Etc.

Oakite Products, Inc.

RETAINING RINGS FOR BEARINGS, ETC.

Waldes Kohinoor, Inc.

RHEOSTATS

Allen-Bradley Co.
General Electric Co.

RIVET SETS

Bethlehem Steel Co.
Cleveland Pneumatic Tool Co.
Cleveland Punch & Shear Works Co.

RIVETERS, Hydraulic

Bethlehem Steel Co.
Hanna Engineering Works
Hannifin Mfg. Co.
Hydraulic Press Mfg. Co.
Morgan Engineering Co.

Pneumatic

Cleveland Pneumatic Tool Co.
Grant Mfg. & Mch. Co.
Hanna Engineering Works
Hannifin Mfg. Co.
Ingersoll-Rand Co.
Ryerson, Joseph T., & Son, Inc.

RIVETING MACHINES

Buffalo Forge Co.
General Riveters, Inc.
Grant Mfg. & Mch. Co.
Hanna Engineering Works
Hannifin Mfg. Co.
Peck, Stow & Wilcox Co.
Producto Machine Co.

RIVET MAKING MACHINES

Hill Acme Co.

RIVETS

Republic Steel Corp.,
(Union Drawn Steel Div.)

RUBBER PRODUCTS

Raybestos-Manhattan, Inc.,
Manhattan Rubber Div.

RULES, Steel

Brown & Sharpe Mfg. Co.
Scherr, George, Co., Inc.
Starrett, L. S., Co.

RUST PREVENTATIVE

Oakite Products, Inc.
Scherr, George, Co., Inc.

SAND BLAST EQUIPMENT

See Blast Cleaning Equipment.

SANDERS

Carborundum Co.
Delta Mfg. Div. Rockwell Mfg. Co.
Ingersoll-Rand Co.
Porter-Cable Machine Co.
Rotor Tool Co.
Sundstrand Mch. Tool Co.
Walls Sales Corp.

SAW BLADES, HACK

Armstrong-Blum Mfg. Co.
Simonds Saw & Steel Co.
Starrett, L. S., Co.

SAW SHARPENING MACHINES

Earle Gear & Mch. Co.
Huther Bros. Saw Mfg. Co., Inc.
Scherr, George, Co., Inc.

SAWING MACHINES

Circular

Consolidated Mch. Tool Corp.
Earle Gear & Mch. Co.
Etna Machine Co.

Friction

Ryerson, Joseph T., & Son, Inc.

Metal Cutting Band

Armstrong-Blum Mfg. Co.
Avey Drilling Machine Co.
Delta Mfg. Div. Rockwell Mfg. Co.
DoAll Co.
Grob Brothers
Huther Bros. Saw Mfg. Co., Inc.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.

Power Hack

Armstrong-Blum Mfg. Co.
Ryerson, Joseph T., & Son, Inc.

SAWS, Circular Metal Cutting

Brown & Sharpe Mfg. Co.
Consolidated Mch. Tool Corp.
Espen-Lucas Machine Works
Genesee Tool Co.
Huther Bros. Saw Mfg. Co., Inc.
National Twist Drill & Tool Co.
Simonds Saw & Steel Co.
Standard Tool Co.
Union Twist Drill Co.
Walker-Turner Co., Inc.

Metal Cutting Band

Armstrong-Blum Mfg. Co.
Delta Mfg. Div. Rockwell Mfg. Co.
DoAll Co., Inc.
Huther Bros. Saw Mfg. Co., Inc.
Ryerson, Joseph T., & Son, Inc.
Starrett, L. S., Co.
Tannewitz Works
Walker-Turner Co., Inc.
Wells Manufacturing Corp.

Screw Slotting

Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Simonds Saw & Steel Co.
Standard Tool Co.
Starrett, L. S., Co.
Union Twist Drill Co.

SCRAPERS, Hand and Power

Anderson Bros. Mfg. Co.

SCREW DRIVING AND NUT SETTING EQUIPMENT

Errington Mechanical Laboratory
Haskins, R. G., Co.
Ingersoll-Rand Co.
Procunier Safety Chuck Co.
Strand, N. A., & Co.

SCREW MACHINES, Automatic, Single and Multiple Spindle

Brown & Sharpe Mfg. Co.
Cleveland Automatic Machine Co.
Cone Automatic Machine Co., Inc.
Foote-Burt Co.
Greenlee Bros. & Co.
National Acme Co.
New Britain-Gridley Mch. Div.,
New Britain Machine Co.
Scherr, George, Co., Inc.
Triplex Machine Tool Corp.

SCREW MACHINES, Hand

See also Lathes, Turret.

Acme Machine Tool Co.
Bardons & Oliver, Inc.
Brown & Sharpe Mfg. Co.
Gisholt Mch. Co.
Hardinge Brothers, Inc.
Jones & Lamson Machine Co.
Rivett Lathe & Grinder, Inc.
Simmons Machine Tool Corp.
Stark Tool Co.
Warner & Swasey Co.

SCREW MACHINE TOOLS AND EQUIPMENT

Bardons & Oliver, Inc.
Brown & Sharpe Mfg. Co.
Cleveland Automatic Machine Co.
Gisholt Mch. Co.
Greenlee Bros. & Co.
Jones & Lamson Machine Co.
Landis Mch. Co., Inc.
National Acme Co.
New Britain-Gridley Mch. Div.,
New Britain Machine Co.
Potter & Johnston Machine Co.
R an L Tools
Warner & Swasey Co.

SCREW MACHINE WORK

Aluminum Co. of America
Eastern Mch. Screw Corp.
Morse Twist Drill & Mch. Co.
National Acme Co.
Standard Pressed Steel Co.

SCREW PLATES

Besly, Chas. H., & Co.
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
Pratt & Whitney Co.

SCREWS

Cap, Set, Safety Set and Machine

Allen Mfg. Co.
American Hardware Co.
American Screw Co.
Atlas Bolt Screw Co.
Bristol Co.
Central Screw Co.
Chandler Products Corp.
Continental Screw Co.
Corbin Screw Co.
Elco Tool & Screw Corp.
General Screw Mfg. Co.
Harper, H. M., & Co.
Holo-Krome Screw Corp.
International Screw Co.
Lamson & Sessions Co.
Milford Rivet & Machine Co.
National Acme Co.
National Lock Co.
National Screw & Mfg. Co.
New England Screw Co.
Parker, Chas., Co.
Parker-Kalon Corp.
Pawtucket Screw Co.
Pheoll Mfg. Co.
Reading Screw Co.
Republic Steel Corp.
(Union Drawn Steel Div.)
Russell, Burdsall & Ward Bolt & Nut Co.
Scovill Mfg. Co.
Southington Hardware Co.
Standard Pressed Steel Co.
Steel Co. of Canada, Ltd.
Sterling Bolt Co.
Stronghold Screw Products
Whitney Screw Corp.
Wolverine Belt Co.

SCREWS, Self-Tapping Drive

Parker-Kalon Corp.

SCREWS, Thumb

American Screw Co.
Parker-Kalon Corp.
Williams, J. H., & Co.

SEALS AND RETAINERS

Oil or Grease

Garlock Packing Co.
Gits Bros. Mfg. Co.

SEAMLESS STEEL TUBING

See Tubing, Seamless Steel.

SECOND HAND MACHINERY, Etc.

Cincinnati Machinery Co., Inc.
Eastern Machinery Co.
Miles Machinery Co.
Morey Mchry. Co., Inc.
Simmons Machine Tool Corp.

SEPARATORS

Centrifugal

DeLaval Separator Co.

Magnetic

Frantz, S. G., Co., Inc.

Oil or Coolant

Barnes Drill Co.
Frantz, S. G., Co., Inc.
National Acme Co.

SHAFTING, STEEL

Bethlehem Steel Co.
Cumberland Steel Co.
Jones & Laughlin Steel Corp.
National Tube Co.
(U. S. Steel Corp., Div.)
Ryerson, Joseph T., & Son, Inc.

SHAFTS

Standard Pressed Steel Co.

Flexible

Haskins, R. G., Co.
Strand, N. A., & Co.

Hollow Bored

American Hollow Boring Co.
Bethlehem Steel Co.

Turned and Ground

Bethlehem Steel Co.
Cumberland Steel Co.
Jones & Laughlin Steel Corp.
Ryerson, Joseph T., & Son, Inc.

SHAPERS

American Tool Works Co.
Atlas Press Co.
Cincinnati Shaper Co.
General Engrg. & Mfg. Co.
Hendey Machine Co.
Machinery Mfg. Co.
Ohio Machine Tool Co.
Rockford Mch. Tool Co.

Vertical

Hanson-Whitney Mfg. Co.
Jones Machine Tool Wks., Inc.
Pratt & Whitney Co.
Rockford Mch. Tool Co.

SHAPES, Structural

Aluminum Co. of America
Bethlehem Steel Co.
Cramp Brass & Iron Foundries Div.
Jones & Laughlin Steel Corp.

SHEARING MACHINERY

Bethlehem Steel Co.
Buffalo Forge Co.
Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Hannifin Mfg. Co.
Hydropress Co., Inc.
Morgan Engineering Co.
Niagara Mch. & Tool Wks.
O'Neil-Irwin Mfg. Co.
Peck, Stow & Wilcox Co.
Quickwork-Whiting Div. of Whiting Corp.
Ryerson, Joseph T., & Son, Inc.
Watson-Stillman Co.
Yoder Co.

SHEARS, Alligator

Hill Acme Co.

SHEARS

Rotary

Bliss, E. W., Co.
Brown & Sharpe Mfg. Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Niagara Mch. & Tool Wks.
Peck, Stow & Wilcox Co.
Quickwork-Whiting Div. of Whiting Corp.
Ryerson, Joseph T., & Son, Inc.
Union Twist Drill Co.

Squaring

Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Niagara Mch. & Tool Wks.
Peck, Stow & Wilcox Co.

SHEET METALS

Aluminum Co. of America
American Brass Co.
Associated Metals
Bethlehem Steel Co.
Ingersoll Steel Div., Borg Warner Corp.
Ryerson, Joseph T., & Son, Inc.

SHEETS, Iron and Steel

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Republic Steel Corp.
(Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.
Ward Steel Co.

Perforated

Chicago Perforating Co.

SINE BARS

Johansson Div., Ford Motor Co.
Starrett, L. S., Co.
Vinco Corporation

SLEEVES

Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Scully-Jones & Co.
Standard Tool Co.
Union Twist Drill Co.

SLOTTING MACHINES
Baker Brothers, Inc.
Consolidated Mch. Tool Corp.
Jones Machine Tool Wks., Inc.
Lobdell Co.
Rockford Mch. Tool Co.
Sellers, Wm., & Co., Inc.

SOCKETS
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
National Twist Drill & Tool Co.
Pratt & Whitney Co.
Scully-Jones & Co.
Standard Tool Co.
Union Twist Drill Co.
Williams, J. H., & Co.

SOLDER FOR ALUMINUM AND CAST IRON
Cramp Brass & Iron Foundries Div.

SPECIAL MACHINERY AND TOOLS
American Measuring Instruments Corp.
American Type Foundries, Inc.
Baird Machine Co.
Baldwin-Southwark Corp.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Bausch Machine Tool Co.
Bethlehem Steel Co.
Bilgram Gear & Mch. Wks.
Birdsboro Steel Fdy. & Mch. Co.
Blanchard Machine Co.
Bliss, E. W., Co.
Columbus Die, Tool & Machine Co.
Consolidated Mch. Tool Corp.
Cross Co.
Denison Engineering Co.
Earle Gear & Mch. Co.
Elgin Tool Wks., Inc.
Ex-Cell-O Corp.
Farrel-Birmingham Co., Inc.
Gairing Tool Co.
Gisholt Mch. Co.
Gorton, George, Mch. Co.
Grant Mfg. & Mch. Co.
Greenlee Bros. & Co.
Hannifin Mfg. Co.
Hartford Special Mchry. Co.
Hydraulic Press Mfg. Co.
Hill Acme Co.
Ingersoll Milling Mch. Co.
Jack & Heintz Precision Industries, Inc.
Jones Machine Tool Wks., Inc.
Lake Erie Engineering Corp.
Langelier Mfg. Co.
Lipe-Rollway Corporation
Moline Tool Co.
Morgan Engineering Co.
Morse Twist Drill & Mch. Co.
National Acme Co.
National Automatic Tool Co.
National Tool Co.
National Twist Drill & Tool Co.
New Britain-Gridley Mch. Div., New Britain Mch. Co.
New Jersey Gear & Mfg. Co.
Niagara Mch. & Tool Wks.
Oilgear Co.
Peck, Stow & Wilcox Co.
Pratt & Whitney Co.
Reed-Prentice Co.
Rogers, John M., Tool Corp.
Ruthman Machinery Co.
S. & S. Mch. Works
Sundstrand Mch. Tool Co.
Taft-Peirce Mfg. Co.
Union Twist Drill Co.
U. S. Tool Company, Inc.
V & O Press Co.
Waltham Mfg. Wks.

SPEED REDUCERS
Atlantic Gear Works, Inc.
Boston Gear Works, Inc.
Cleveland Worm & Gear Co.
Davis & Thompson Co.
DeLaval Steam Turbine Co.
Farrel-Birmingham Co., Inc.
Foote Bros. Gear & Machine Corp.
Ganschow Gear Co.
General Electric Co.
Grant Gear Works, Inc.
James, D. O., Mfg. Co.
Master Electric Co.
Michigan Tool Co.
Morse Chain Co.
Philadelphia Gear Works
Shepard Niles Crane & Hoist Corp.

SPINDLES, Grinding
Ex-Cell-O Corporation
Pope Machinery Corp.

SPINDLES, Hollow Bored
American Hollow Boring Co.

SPINNING LATHES
See Chucking Machines.

SPRING COILING AND FORMING MACHINERY
Baird Machine Co.

SPROCKET CHAINS
Atlantic Gear Works, Inc.
Boston Gear Works, Inc.
Grant Gear Works, Inc.
Morse Chain Co.
Philadelphia Gear Works

SPROCKETS
Atlantic Gear Works, Inc.
Boston Gear Works, Inc.
Eberhardt-Denver Co.
Foote Bros. Gear & Machine Corp.
Grant Gear Works, Inc.
Hartford Special Mchy. Co.
Morse Chain Co.
Philadelphia Gear Works

STAMPINGS, Sheet Metal
Adams Stamping Co.
Aluminum Co. of America
Quadriga Mfg. Co.

STAMPINGS, Steel
Worcester Pressed Steel Co.

STAMPS, Steel, and Marking Dies
Noble & Westbrook Mfg. Co.
Pittsburgh Stamp Co., Inc.
Sossner, Inc.

STEEL
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Frasse, Peter A., & Co., Inc.
Ingersoll Steel Div., Borg Warner Corp.
Jones & Laughlin Steel Corp.
Republic Steel Corp. (Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Timken Roller Bearing Co.
Vanadium Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

Cold Drawn
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Jones & Laughlin Steel Corp.
Rustless Iron & Steel Div., American Rolling Mills Co.
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
Wheelock, Lovejoy & Co., Inc.

Composite Tool and Die
Firth-Sterling Steel Co.

High Speed Tool
Allegheny Ludlum Steel Corp.
Armstrong Bros. Tool Co.
Bethlehem Steel Co.
Carpenter Steel Co.
Cleveland Twist Drill Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Republic Steel Corp. (Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Vanadium Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

Machine
Bethlehem Steel Co.
Crucible Steel Co. of America
Jones & Laughlin Steel Corp.
Republic Steel Corp. (Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
Vanadium Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

Rustless
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Ingersoll Steel & Disc Div., Borg Warner Corp.
Republic Steel Corp. (Union Drawn Steel Div.)
Rustless Iron & Steel Div., American Rolling Mills Co.

Stainless
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Frasse, Peter A., & Co., Inc.
Ingersoll Steel Div., Borg Warner Corp.
Republic Steel Corp. (Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.
Rustless Iron & Steel Div., American Rolling Mills Co.
Timken Roller Bearing Co.
Wheelock, Lovejoy & Co., Inc.

Strip and Sheet
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Frasse, Peter A., & Co., Inc.
Jones & Laughlin Steel Corp.
Republic Steel Corp. (Union Drawn Steel Div.)
Ryerson, Joseph T., & Son, Inc.
Ward Steel Co.

Zinc, Tin and Copper Coated Strip
Allegheny Ludlum Steel Corp.

STEEL ALLOYS
See Alloy Steels.

STEEL BARS—See Bars, Steel.

STEEL STOCK GROUND FLAT
Brown & Sharpe Mfg. Co.
Starrett, L. S., Co.

STELLITE
Haynes Stellite Co.

STOCKS, Die
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
Oster Manufacturing Co.
Pratt & Whitney Co.
Standard Tool Co.

STONES, Oil or Sharpening
Bay State Abrasive Co.
Carborundum Co.

STOOLS
Standard Pressed Steel Co.

STRAIGHT EDGES
Brown & Sharpe Mfg. Co.
Johansson Div., Ford Motor Co.
Jones Machine Tool Wks., Inc.
Starrett, L. S., Co.

STRAIGHTENING MACHINERY
Baldwin-Southwark Corp.
Consolidated Mch. Tool Corp.
General Manufacturing Co.
Hannifin Mfg. Co.
Hydraulic Press Mfg. Co.
Lake Erie Engineering Corp.
Morse Twist Drill & Mch. Co.
Oilgear Co.
Springfield Mch. Tool Co.
Waterbury Farrel Fdry. & Mch. Co.

STUD SETTERS
Errington Mechanical Laboratory
Modern Tool Wks.
Procunier Safety Chuck Co.

SUB PRESSES
Baumbach, E. A., Mfg. Co.
U. S. Tool Co.
Waltham Mch. Wks.

SUPERFINISHING MACHINES
Norton Co.

SURFACE PLATES
See Plates, Surface.

SWAGING MACHINES
Cincinnati Shaper Co.
Etna Machine Co.
Langelier Mfg. Co.
Torrington Co.

SWITCHES
Allen-Bradley Co.
Cook Electric Co., Diaphlex Div.,
General Electric Co.
Lincoln Electric Co.
National Acme Co.
Shepard Niles Crane & Hoist Corp.
Westinghouse Electric Corp.

TACHOMETERS
Bristol Co.
Ideal Industries, Inc.
Leeds & Northrup Co.
Scherr, George, Co., Inc.
Sticht, Herman H., Co., Inc.
Veeder-Root, Inc.

TAPER PINS, STANDARD
Morse Twist Drill & Mch. Co.
Pratt & Whitney Co.

TAP EXTENSIONS
Allen Mfg. Co.

TAP HOLDERS
Errington Mechanical Laboratory
Gairing Tool Co.
McCrosky Tool Corp.
National Automatic Tool Co.
Procunier Safety Chuck Co.
Scully-Jones & Co.

TAPPING ATTACHMENTS AND DEVICES
Avey Drilling Machine Co.
Baker Brothers, Inc.
Brown & Sharpe Mfg. Co.
Buhr Machine Tool Co.
Detroit Tap & Tool Co.
Errington Mechanical Laboratory
Ettco Tool Co.
Kaufman Manufacturing Co.
Leland-Gifford Co.
McCrosky Tool Corp.
Modern Tool Wks.
National Automatic Tool Co.
Procunier Safety Chuck Co.

TAPPING MACHINES
Armstrong-Blum Mfg. Co.
Avey Drilling Machine Co.
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Baush Machine Tool Co.
Bodine Corp.
Bradford Machine Tool Co.
Buffalo Forge Co.
Buhr Machine Tool Co.
Cleveland Tapping Machine Co.
Cross Co.
Detroit Tap & Tool Co.
Elgin Tool Wks., Inc.
Frew Machine Co.
Geometric Tool Co.
Greenlee Bros. & Co.
Haskins, R. G., Co.
Hill Acme Co.
Kaufman Manufacturing Co.
Kingsbury Mch. Tool Corp.
Langelier Mfg. Co.
Leland-Gifford Co.
Modern Tool Wks.
Moline Tool Co.
National Acme Co.
National Automatic Tool Co.
Procunier Safety Chuck Co.
Warner & Swasey Co.

TAPPING MACHINES, Nut
Hill Acme Co.

TAPS
Bath, John, & Co., Inc.
Bealy, Chas. H., & Co.
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Continental Tool Works Div.
Detroit Tap & Tool Co.
Electrolized Tap Corp.
Geometric Tool Co.
Greenfield Tap & Die Corp.
Hanson-Whitney Mch. Co.
Landis Mch. Co.
Morse Twist Drill & Mch. Co.
National Acme Co.
Pratt & Whitney Co.
Standard Tool Co.
Threadwell Tap & Die Co.
Wood & Spencer Co.
Woodworth, N. A., Co.

Collapsing
Geometric Tool Co.
Landis Mch. Co., Inc.
Modern Tool Wks.
National Acme Co.

TESTING EQUIPMENT, Tension, Compression, Fatigue, Etc.
Hydraulic Press Mfg. Co.

THERMOMETERS, Indicating and Recording
Bristol Co.
Leeds & Northrup Co.

THREAD CUTTING MACHINERY
Brown & Sharpe Mfg. Co.
Eastern Machine Screw Corp.
Fellows Gear Shaper Co.
Geometric Tool Co.
Grant Mfg. & Mch. Co.
Hill Acme Co.
Kaufman Manufacturing Co.
Landis Mch. Co., Inc.
Modern Tool Works
Oster Manufacturing Co.
Pratt & Whitney Co.
Rivett Lathe & Grinder, Inc.
Rogers Machine Works, Inc.
Taft-Peirce Mfg. Co.

THREAD CUTTING TOOLS
Armstrong Bros. Tool Co.
Detroit Tap & Tool Co.
Eastern Machine Screw Corp.
Geometric Tool Co.
Hill Acme Co.
Landis Mch. Co., Inc.
Modern Tool Works
Oster Manufacturing Co.
Pratt & Whitney Co.
Rivett Lathe & Grinder, Inc.
Taft-Peirce Mfg. Co.
Williams, J. H., & Co.

THREAD GAGES
See Gages, Thread.

THREAD GRINDING MACHINES
See Grinding Machines, Thread.

THREAD MILLING MACHINES
Coulter James, Machine Co.
Cross Co.
Hanson-Whitney Mch. Co.
Pratt & Whitney Co.
Waltham Mch. Wks.

THREAD ROLLING MACHINES
Hill Acme Co.
Peck, Stow & Wilcox Co.
Rolled Thread Die Co.
V & O Press Co.

TIN AND TERNE PLATES
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Republic Steel Corp. (Union Drawn Steel Div.)

TOOL BITS

High Speed Steel
Allegheny Ludlum Steel Corp.

Armstrong Bros. Tool Co.
Barber-Colman Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Vanadium Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.
Williams, J. H., & Co.

Special Alloy

Allegheny Ludlum Steel Corp.
Firth-Sterling Steel Co.
Haynes Stellite Co.

TOOL GRINDERS

See Grinders for Sharpening Turning and Planing Tools.

TOOL HEADS, Adjustable

Gairing Tool Co.

TOOL HOLDERS

Armstrong Brothers Tool Co.
Cleveland Twist Drill Co.
Gisholt Machine Co.
Jones & Lamson Mch. Co.
Lovejoy Tool Co., Inc.
Michigan Tool Co.
R and L Tools
Scully-Jones & Co. (turret)
Warner & Swasey Co.
Williams, J. H., & Co.

TOOLMAKERS' INSTRUMENTS

Brown & Sharpe Mfg. Co.
Scherr, George, Co., Inc.
Starrett, L. S., Co.

TOOL STEEL

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Firth-Sterling Steel Co.
Ryerson, Joseph T., & Son, Inc.

TOOLS

Carbide-Tipped

Allegheny Ludlum Steel Corp.
Carboloy Co., Inc.
Ex-Cell-O Corporation
Firth-Sterling Steel Co.
Gairing Tool Co.
Kennametal, Inc.
Lincoln Park Industries, Inc.
Metal Carbides Corp.
Michigan Tool Co.
Morse Twist Drill & Mch. So.
Vanadian Alloys Steel Co.

Lathe, Shaper and Planer

Armstrong Brothers Tool Co.
Firth-Sterling Steel Co.
Genesee Tool Co.
Gisholt Machine Co. (For Lathes Only)
Haynes Stellite Co.
Illinois Tool Wks.
Jones & Lamson Mch. Co.
Kennametal, Inc.
Warner & Swasey Co.
Williams, J. H., & Co.

TRANSFORMERS

General Electric Co.

TRANSMISSION MACHINERY

See Hangers, Shafting, Pulleys, Clutches, Coupling, Belting, Chains, Etc.

TRANSMISSION, Variable Speed

DoAll Co.
Dynamatic Corp.
Ideal Industries, Inc.
Oilgear Co.
Reeves Pulley Co.

TUBE FLANGING MACHINES

Grant Mfg. & Mch. Co.

TUBING, Aluminum

Aluminum Co. of America

TUBING

Brass and Copper

American Brass Co.

Stainless Steel

Allegheny Ludlum Ste... ...
Carpenter Steel Co.
National Tube Co. (U. S. Steel Corp., Div.)
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.

Steel and Seamless Steel

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Frasse, Peter A., & Co., Inc.
Jones & Laughlin Steel Corp.
National Tube Co. (U. S. Steel Corp., Div.)
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
Ward Steel Co.

TUMBLING BARRELS

Baird Machine Co.

TUNGSTEN CARBIDE

Allegheny Ludlum Steel Corp.
Carboloy Co., Inc.
Firth-Sterling Steel Co.
Kennametal, Inc.
Metal Carbides Corp.

TWIST DRILLS

See Drills, Twist.

UNIONS

Dart, E. M., Mfg. Co.

UNIVERSAL JOINTS

Baush Machine Tool Co.

Boston Gear Works, Inc.
National Automatic Tool Co.

V-BELTS

Manheim Mfg. & Belting Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

VALVES

Hydraulic

Baldwin-Southwark Corp.
Barnes, John S., Corp.
Elmes Engineering Works
Galland-Henning Mfg. Co.
Hannifin Mfg. Co.
Oilgear Co.
Sundstrand Mch. Tool Co.
Valvair Corp.
Watson-Stillman Co.

Pneumatic

Anker-Holth Mfg. Co.
Hanna Engineering Works
Hannifin Mfg. Co.

VISES

Bench

Avey Drilling Machine Co.
Desmond-Stephan Mfg. Co.
Vinco Corporation

Machine

Armstrong-Blum Mfg. Co.
Armstrong Brothers Tool Co.
Avey Drilling Machine Co.
Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Desmond-Stephan Mfg. Co.
Graham Mfg. Co., Inc.
Hannifin Mfg. Co.
Jefferson Machine Tool Co.
LeBlond, R. K., Mch. Tool Co.
Sheldon Mch. Co.
Skinner Chuck Co.

Pipe

Greenfield Tap & Die Corp.
Williams, J. H., & Co.

Planer and Shaper

Brown & Sharpe Mfg. Co.
Cincinnati Planer Co.
Cincinnati Shaper Co.
Graham Mfg. Co., Inc.
Hendy Machine Co.
Rockford Machine Tool Co.
Skinner Chuck Co.

VOCATIONAL EDUCATION

Jordanoff Corp.

VOLTMETERS

Bristol Co.
General Electric Co.

WASHERS, Lock

Quadriga Mfg. Co.

Spring

Quadriga Mfg. Co.

WELDING AND CUTTING EQUIPMENT, Oxyacetylene

Air Reduction Sales Co.
Linde Air Products Co.

WELDING AND CUTTING GASES

Air Reduction Sales Co.
Linde Air Products Co.

WELDING EQUIPMENT, Electric Arc

Air Reduction Sales Co.
General Electric Co.
Lincoln Electric Co.
Master Electric Co.
Westinghouse Electric Corp.

Electric, Spot, Butt, Seam, Etc.

Federal Machine & Welder Co.
Taylor-Winfield Corp.
Victory Engrg. & Mch. Wks., Inc.

WELDING POSITIONER

Cullen-Friestedt Co.

WHITE PRINTS, Paper and Machine

Ozalid Div., General Aniline & Film Corp.

WIRE

Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Republic Steel Corp. (Union Drawn Steel Div.)
Rustless Iron & Steel Div. American Rolling Mills Co.
Ward Steel Co.

WIRE FORMING MACHINERY

Baird Machine Co.
U. S. Tool Co., Inc.

WIRE NAIL MACHINERY

Bliss, E. W., Co.
Ryerson, J... T., & Son, Inc.

WOOD... ...NG MACHINERY

Sidney Machine Tool Co.
Walker-Turner Co., Inc.

WORM DRIVES

Cleveland Worm & Gear Co.
DeLaval Steam Turbine Co.
Philadelphia Gear Works

WRENCHES

Armstrong Brothers Tool Co.
Standard Tool Co.
Williams, J. H., & Co.

Detachable Socket

Williams, J. H., & Co.

Pipe

Greenfield Tap & Die Corp.

Ratchet

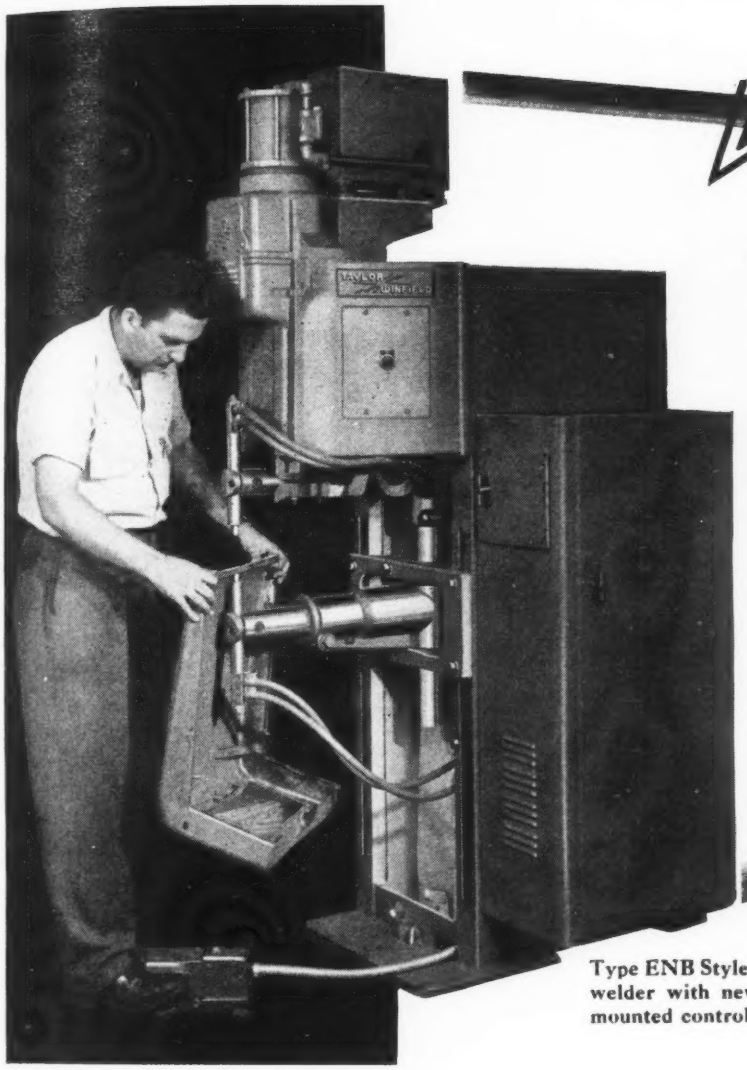
Williams, J. H., & Co.

Tap

Beaiy, Chas. H., & Co.
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
Pratt & Whitney Co.
Standard Tool Co.

Torque Measuring

Elastic Stop Nut Corp. of America
Williams, J. H., & Co.



NEW

Type ENB Style 4 spot welder with new side mounted controls.

See this new ENB press welder at the National Metal Show in Atlantic City, Nov. 18-22.
Booth G-229.

TAYLOR-WINFIELD ANNOUNCES NEW TYPE *ENB* AIR OPERATED PRESS WELDERS

These welders are available in two styles. Style 1 is either a projection welder or a combination projection and spot welder when horns are used. The style 4 is a spot welder with a swiveling lower horn.

The projection welder is supplied in throat depths ranging from 12 to 30 inches and the spot welder from 18 to 36 inches. Electrical ratings are 30, 50, or 75 KVA.

These new press welders are built to present day requirements for rugged and precise resistance welding. They are designed and tested for long life and low maintenance costs.

FEATURES

- ✓ Roller Anti-Friction welding head.
- ✓ Bellows Air Lock.
- ✓ Provision for use of side mounted electrical controls.
- ✓ Transformer design of "damage resisting" construction.
- ✓ Air valves mounted adjacent to air cylinders—gives low air consumption and high operating speeds.
- ✓ Tap switches connected to transformer without flexing primary leads.
- ✓ Composite copper-steel knee construction of Style 1 welders insures highest rigidity.
- ✓ Rigidly supported swiveling lower horn of Style 4 welders provides maximum flexibility.

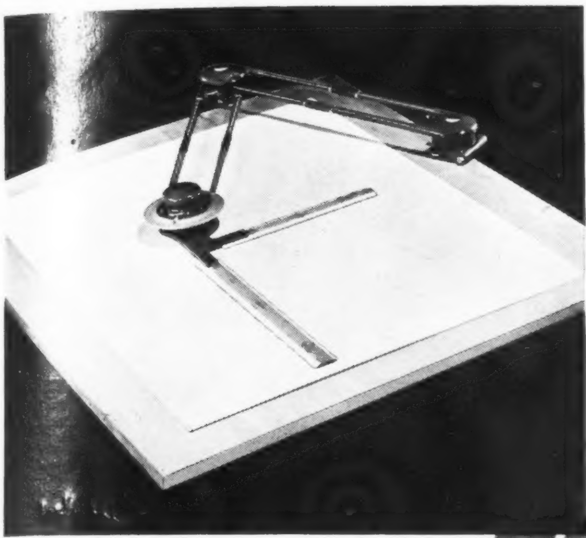
Write for the new Taylor-Winfield ENB Bulletin 3-113. Contains 8 pages of useful information, specifications, descriptions and illustrations. Send for your copy today.

The TAYLOR-WINFIELD CORPORATION
WARREN . . . OHIO

TAYLOR-WINFIELD RESISTANCE WELDERS

ALPHABETICAL INDEX OF ADVERTISERS

ALPHABETICAL INDEX OF ADVERTISERS—Continued



HORIZONTAL

Designed as a standard basic unit applicable to horizontal boards, the BOARDMASTER fulfills all the requirements at minimum cost through the elimination of all unnecessary mechanisms. Flexibility and economy are made possible by means of standard "packaged" stabilizing units. (See below).

3 MACHINES IN 1

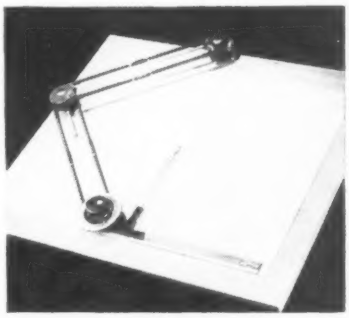
THE NEW UNIVERSAL

BOARDMASTER

DRAFTING MACHINE

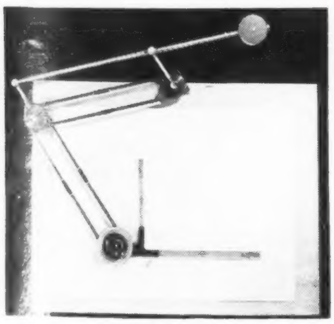
How do you plan to use your BOARDMASTER now? Horizontally? Sloping? Vertically? How do you expect to use it in the future? Whatever your plans, the BOARDMASTER will meet future requirements as readily as it does your immediate needs. The Standard Unit (above) is designed for horizontal operation at minimum cost, because all unnecessary mechanisms have been eliminated. Yet this basic unit can be quickly adapted to sloping or vertical board operation by means of inexpensive stabilizing units, quickly attached.

RANGE OF OPERATION — Built in two sizes, with 24″ and 30″ arms, Universal BOARDMASTERS cover all boards from 36″ x 48″ to 48″ x 72″. Full-vision, full-circle protractor is graduated 0°—90° in all four quadrants. Baseline selector gives full 360° coverage. Indexing control provides automatic indexing every 15°. Vernier gives direct readings to 5 minutes. Rigid construction makes possible accurate projection of long lines. Centralized Control Group allows left hand control of all operations, virtually by "feel" alone. Ground index rings, diamond turned pulleys and precision, preloaded ball bearings insure lasting accuracy. The new illustrated Bulletin gives part-by-part descriptions of the BOARDMASTER's many new features. Write for your copy.



SLOPING

Entirely new cartridge type stabilizers, incorporating an eccentric cam principle with fully corrected spring counter-balancing, can be attached in a few minutes to the standard BOARDMASTER to give correct balance at all board angles from 0° to 20°.



VERTICAL

F... rictionless balancing at all board a... from 0° to 90°, a new weight t... stabilizer can be quickly attached. A... tabilizers are available in two ... for use on 24″ and 30″ machines.

UNIVERSAL DRAFTING MACHINE CO., CLEVELAND 14, OHIO

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